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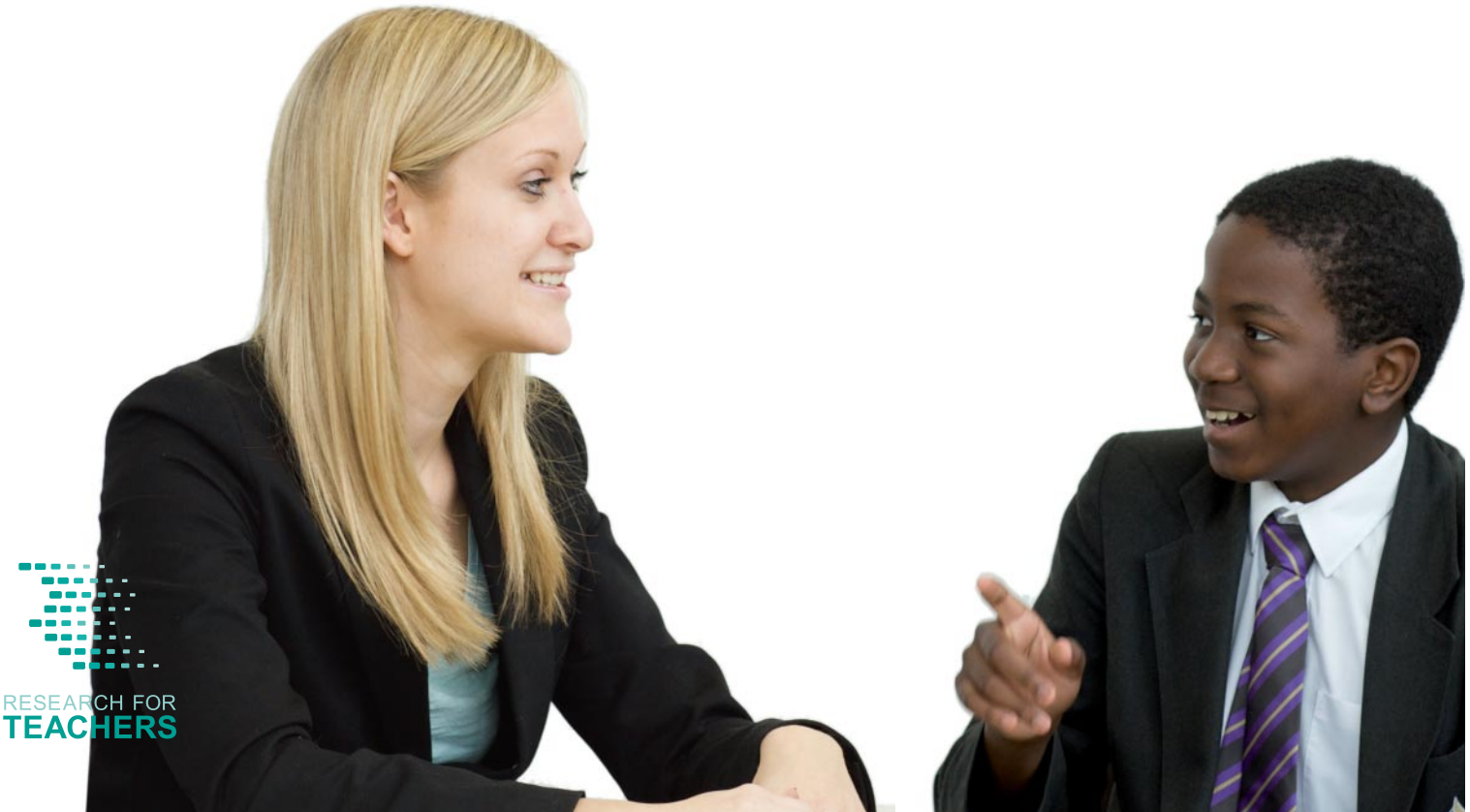
CREATING A CURRICULUM FOR LEARNING

General Teaching Council for England

Research for Teachers anthology 4



RESEARCH FOR TEACHERS

CONTENTS

SECTION 1
INTRODUCTION

How teachers can create effective curriculum experiences for young people

For a long time, 'curriculum' meant 'subject content'. In recent years, curriculum has been seen in terms of planning content and pedagogy simultaneously, and understanding the important interrelationship between the two. For example, the New Zealand Best Evidence Synthesis of effective pedagogy in social sciences[1], shows how content and pedagogy go hand in hand – curriculum experiences need to be aligned with learning intentions and outcomes (which are based on teachers' knowledge of what pupils already know and can do). Whatever decisions are made at national level regarding content, teachers will always have the job of creating effective curriculum experiences for the young people in their classrooms. This means that they need deep knowledge both of their subject and of pedagogy.

This anthology sets out to help teachers use what is known about effective pedagogy and apply it to their everyday knowledge of the content of the curriculum in order to help them create meaningful and effective curriculum experiences for their pupils. The definition of curriculum which underpins the anthology is that it encompasses the entire planned learning experiences of young people in school.

The anthology is structured around evidence from a study[2] which synthesised evidence from three years (2007-10) of research undertaken in support of the remit of the Qualification and Curriculum Development Agency (QCDA) to monitor and develop the curriculum. Overall, this evidence suggests that, in order to create effective pupil learning from curriculum content:

- teachers should be offered an opportunity to be involved in developing the curriculum for their pupils; and
- curriculum development needs to be aligned with whole-school processes and complemented by staff professional development.

The QCDA evidence also suggests that curriculum development at practitioner level frequently manifests itself as:

- planning of curriculum experiences that take into account the needs, interests and developmental priorities of young people; and
- its **enactment**, that is teachers working with the pupils to realise the curriculum experiences and implement their plans for particular groups of learners.

This is all much easier to say than to do. That's why, in this anthology, we have also scoured the Teacher Learning Academy (TLA) research evidence base as well as research undertaken in support of QCDA's work, to find the key messages from the research surrounding curriculum development in its broader sense. We have also included illustrative case studies to help bring the messages to life. We hope teachers and leaders in all phases will find this anthology helpful as they plan meaningful curriculum experiences for their pupils.

1 Aitken, G. and Sinnema, C. (2008) *Effective pedagogy in social sciences: Best Evidence Synthesis Iteration (BES)*, New Zealand Ministry of Education, Wellington, New Zealand. Available at: www.educationcounts.govt.nz/publications/series/2515/32879/35263

2 Curee and University of Wolverhampton (forthcoming) *Monitoring the curriculum: evidence from research, practice and learners*, Curee, Coventry

How this anthology is organised

The anthology is organised into three interconnected sections: whole-school processes, planning, and enactment.

First we present the evidence about the frameworks and processes needed to underpin effective curriculum development in schools. In particular we look at:

- the important links between curriculum development, staff continuing professional development (CPD) and whole school improvement priorities;
- activities and mechanisms that can effectively support both CPD and curriculum development; and
- tools and frameworks, underpinning effective curriculum development and CPD.

Then we take a look at the evidence about planning the curriculum, focusing in particular on planning for:

- context-based learning; and
- making curriculum links between home and school.

Finally, we explore the evidence about the effective enactment of the curriculum in the classroom through:

- structured group work;
- building on pupils' starting points;
- challenging common misconceptions; and
- building challenge in to the curriculum.

Each section concludes with some suggestions for ways that teachers and leaders can act upon the messages in the research. These are often in 'evidence boxes', which show the TLA research summaries that underpin an area of study. These summaries were compiled by Curee for the General Teaching Council: see page 58 for more information.

Throughout the anthology, case studies of action research by teachers are highlighted that illustrate some of the approaches described. You will find the case studies followed by suggestions for other related research summaries and resources at the end of the anthology.

How to get the most out of this anthology

We have structured this anthology so that you can easily access the parts that are most interesting and useful to you.

Teachers may find it most useful to:

- identify an issue that you are finding it difficult to plan for and then find the section or sub-section that concerns the issue:
  - first read the section and related case study or case studies (the research summaries referred to in this anthology include further case studies which you may find useful too);
  - then consider the 'how could you make use of this evidence…' section as a starting point for looking into how you can use the evidence base to make an impact on teaching and learning in your own context;
  - work with your colleagues to pursue development activity or enquiry and dig deeper by accessing further evidence, especially the original research summaries.

Leaders of professional learning may find it most useful to:
introduce a relevant sub-section or two per meeting to support discussion about learning and planning effective approaches;

- use a sub-section to support collaborative work, enabling each teacher to concentrate on specific issues related to their classroom; and
- introduce relevant sub-sections to professional studies programmes for NQTs for general information and to support enquiry.

SECTION 2
WHOLE-SCHOOL PROCESSES

This section explores what motivates schools, their leaders and individual teachers to get involved in developing curricular content and pedagogy in a connected way. It considers the benefits of participating in curriculum development, ranging from contributing to whole-school improvement to engaging disaffected learners. Finally, this section highlights how curriculum development needs to be supported at a whole-school level in order to be effective.

How does curriculum development relate to school development and CPD?

Why initiate curriculum development?

Curriculum development can result in benefits for pupils, teachers and the school. For example, the research summary *Alternative curriculum provision* explored how developing the curriculum can help schools move from an 'exclusion' approach, where disaffected pupils were rejected by their school, to a more inclusive approach. The schools developed the curriculum so that it provided for all their pupils and re-engaged disaffected pupils in school life through satellite, extension and complementary programmes.

Schools that are successful in implementing curriculum development[3] highlight a number of reasons for getting involved in the process in the first place:

- increasing pupils' motivation to learn;
- increasing pupils' participation and engagement;
- supporting pupils to become more independent/ confident; and
- encouraging pupils to take responsibility for their own learning.

The process of curriculum development in these schools also provided new and additional opportunities for realising school development priorities and created the need and the environment for staff learning and development.

How can curriculum development be linked with CPD and whole-school priorities?

The international evidence base[4] highlights the importance of effective CPD for all aspects of curriculum development. Teachers need deep knowledge both of their subject and of pedagogy to be able to shape the curriculum content and experience in ways that are most beneficial for their pupils.

A longitudinal curriculum research project[5] showed that schools that were effective curriculum innovators supported curriculum development through CPD at every stage, aligning the two through collaborative professional development and the design of curriculum materials and resources. In this context, teachers saw both the CPD and the curriculum development processes as being about doing their job better.

For school leaders, curriculum development, and the linked staff development, can help realise school development plans. For example, a study of how school leaders were managing the changes required by curriculum innovation showed how some schools chose curriculum development as a way of improving pupil attainment in writing and increasing pupils' enquiry and problem solving skills, because the leaders believed changing the curriculum would have a direct effect on achievement and attainment[6].

Case study 1 (page 28) shows how curriculum development helped realise school development plans related to improving specific aspects of learning.

3 Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?*, paragraph 44, Curee, Coventry

4 Bell, M., Cordingley, P. and Goodchild, L. (2008) *QCA Building the Evidence Base: Map of research reviews*, Curee, Coventry. Available at: http://www.curee-paccts.com/our-projects/qcda-building-evidence-base
Bell, M., Cordingley, P., Gibbons, S. and Hawkins, M. (2008) *QCA Building the Evidence Base: Review of individual studies from Systematic Research Reviews*, Curee, Coventry. Available at: http://www.curee-paccts.com/our-projects/qcda-building-evidence-base

5 Curee and University of Wolverhampton (forthcoming) *Monitoring the curriculum: evidence from research, practice and learners*, Curee, Coventry

6 Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?*, Curee, Coventry

How can schools support curriculum development?

Introducing curriculum development places a requirement on teachers to significantly alter their existing practice. The study of how school leaders were managing the changes required by curriculum innovation referred to above[7] showed how school leaders supported colleagues to make the necessary changes through programmes of support, which typically included:

- multiple (up to three) in-service training (INSET) days;
- ongoing one-to-one coaching and mentoring from the curriculum development leader for individual members of staff;
- observation;
- experimentation with new approaches; and
- development of tools and resources to model and support curriculum development and enactment.

You can find out more about the CPD processes and activities that support curriculum development in the next section.

How can schools monitor and evaluate curriculum development?

The participants in the study reported in the research summary *Alternative Curriculum Provision* suggested that their monitoring and evaluation of the alternative curriculum programmes involved:

- determining criteria for judging success;
- considering how different types of evidence could be collected to show the effects of the programme;
- considering the timing and phases of evaluation; and
- using evaluation data to inform and develop future programmes.

The study of how effective schools manage curriculum development showed that the schools recognised the importance of monitoring curriculum development[8] and at the same time tried to avoid creating any new or additional procedures for evaluation and accountability purposes. Instead they used the same mechanisms for monitoring as they had designed to offer support. These included INSET days, coaching and mentoring, observation, experimentation and use of appropriate tools.

For example, observation (both the actual practice of it and the expectation that it would happen) made teachers' practice and its development available for scrutiny by others. This approach of balancing challenge and support through the same mechanisms enabled school leaders to be both deeply involved in the development and efficient in their use of time.

The study[9] further emphasised that, in most of the schools that effectively implemented curriculum development, their leaders, often head teachers, were actively involved in the process of curriculum development, implementation and especially its review. Effective leaders modelled both the new approaches and the learning behaviours and outcomes they sought for young people and for their colleagues.

Case study 2 (page 29) illustrates how a school leader's active involvement in curriculum development helped drive and monitor the development. It also shows how the school supported learners in participating in the ongoing process of curriculum development.

7 Ibid, paragraph 49
8 Ibid
9 Ibid

What CPD processes help teachers to develop the curriculum effectively?

Evidence[10] suggests that supporting curriculum change and staff CPD can be effective and efficient at the same time, if the existing CPD arrangements are utilised to serve dual purposes, as in the examples below.

Multiple INSET days

These often included 'big picture' contributions from a range of specialists, including school leaders, followed by workshops in which groups of staff worked together on planning and creating curriculum resources. In one primary school for example, the head teacher made a presentation to the whole staff at an INSET day about the 'big idea' of a new curriculum and what she hoped it would add to the school and to pupil learning. Members of staff then worked together in teams to simulate planning using the new framework. They imagined a topic they might choose under one of the themes, and planned curriculum experiences that would support children's learning as they explored the theme.

The research summary *Leading staff development in primary mathematics* also found that for a whole-school INSET day to work well, it was important to encourage discussion by all members of staff present. This was done, for example, by displaying new resources and discussing their use or exploring practical ideas for particular year groups.

Peer support

There is much evidence of the importance of peer support in curriculum development. This enhances the findings from the research summary *The impact of collaborative CPD*, which highlighted how peer support was key to the CPD that was linked to positive pupil and teacher outcomes.

In schools involved in curriculum development, teachers usually work in very carefully selected teams, variously described as learning or year group partnerships, planning or enquiry teams. The teams can involve groups of teachers considering the challenges of particular curriculum areas in-depth or be drawn from across different subjects.

In research reported by the research summary *The role of the specialist in CPD*, two teams of middle school teachers each consisted of literacy, science, mathematics, and social studies practitioners. The teams worked together to plan and implement new reading strategies for pupils, many of whom struggled with reading. In one instance of such team effort, the literacy teacher introduced the word identification strategy and the science and social studies practitioners applied the strategy using subject-specific vocabulary. The strategy was then implemented across all classes.

The research summary *The role of specialists in CPD* contextualises this finding. A study of teachers who were participating in technology CPD programmes focused on their collaboration of practitioners through teaching each other and group reflection. The study reported a number of positive outcomes of such an approach, including learning from each other in a 'risk-free' environment.

Specialist support

Specialist expertise is frequently mobilised in order to support teams of teachers undertaking curriculum development. External expertise can come from a variety of sources including creative arts professionals, pupil voice and CPD consultants, local authority advisers and a professional subject body.

Identification and deployment of internal specialist curriculum expertise can also be particularly valuable. In these instances, colleagues who are internal to the overall organisation can play the part of external experts. For example, the ICT specialist can advise a curriculum group on the use of a virtual learning environment (VLE) for developing and sharing resources. By recognising and developing their internal expertise, schools can make the most of the opportunity to build their internal capacity.

10 Ibid

The research summary *The role of specialists in CPD* offers examples of how external specialists can gradually move towards playing a more facilitative role, supporting teachers to take control and ownership of the new approaches to curriculum, thus increasing schools' capacity to sustain development. Some of the strategies used by specialists included:

- involving teachers in designing teaching and learning activities whilst providing intensive support which they gradually withdrew;
- modelling new approaches and supporting teachers in practising different aspects with their classes; and
- developing some teachers as 'champions' or leaders of their colleagues' learning.

Case study 3 (page 31) describes how specialists supported classroom practitioners in developing the science curriculum at Key Stage 1.

Observation and feedback

The importance of observation and feedback was considered in the research summary *Teachers' professional learning*. In some cases it was used by researchers or specialists supporting practitioners to explore the ways teachers were implementing new approaches and strategies and to offer them feedback. In other instances, observation and feedback occurred as part of peer support and collaboration in developing new teaching materials and approaches. One study showed the possibility of linking specialist and peer observation and feedback by using the classroom observation evidence from each teacher in the team as a basis for reflective discussions between practitioners and specialists and further development of the approach and colleagues' knowledge and skills.

Experimentation

The importance of experimenting during the process of developing and applying new materials and approaches has been highlighted in the TLA research summaries about CPD: *The role of the specialist in teachers' CPD, Teachers' professional learning* and *The impact of collaborative CPD in the classroom.* It was also essential for implementing curriculum development: working in the environment in which risk taking was encouraged and supported was emphasised by teachers as an important support mechanism for developing new curriculum experiences[11].

Case study 4 (page 32) shows how teachers experimented with various approaches and strategies while developing the design and technology curriculum for disadvantaged pupils.

What role do tools and resources play in curriculum development and CPD?

The study[12] of schools that were effective in managing curriculum development has shown how adaptation and refinement of existing approaches and resources can be a significant part of curriculum development. Pairs and teams of teachers developed rubrics and frameworks to support plans for curriculum experiences in accordance with the new or adapted approach, and a range of curriculum resources and assessment tools. At the same time, another curriculum research project[13] has shown how tools and resources have, in the specific context of curriculum development, the potential to:

- embed the curriculum change at scale and mediate it at a whole school level; and
- support staff professional development, when teachers are involved in developing and refining them for specific groups of pupils and contexts.

11 Ibid
12 Ibid
13 Curee and University of Wolverhampton (forthcoming) *Monitoring the curriculum: evidence from research, practice and learners*, Curee, Coventry

Why do schools choose to develop their own curriculum resources?

The TLA research summary *Transforming teaching and learning with ICT* found that developing and utilising various ICT and media tools and resources, and offering pupils choice in using them, can lead to improving their motivation and performance.

The study[14] of schools involved in curriculum development identified further reasons why school leaders and staff developed their own curriculum resources or significantly adapted the existing ones, including:

- dissatisfaction with the quality and usefulness of the 'off the shelf' resources (because 'resources from elsewhere don't always work for our school, so we adapt them for our setting');
- a belief that the school curriculum should be bespoke and belong to the school;
- continuous review and development of the curriculum, resulting in the need for new resources; and
- a view of the development of curriculum resources as an important source and opportunity of CPD for the staff.

Research reported in the research summary *Leading staff development in primary mathematics* reached similar conclusions. It also highlighted how relying on commercially produced (mathematics) schemes of work was not in the best interests of either pupils' learning or the teachers' own professional development.

Case study 5 (page 34) describes how a group of mathematics teachers improved their pupils' learning experiences and renewed their enthusiasm for teaching mathematics through developing new teaching and learning resources.

14 Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?*, Curee, Coventry

What kind of tools help in curriculum development?

Examples of the tools used by the schools to support curriculum development included:

- rubrics (protocols);
- audit tools;
- planning grids and templates; and
- toolkits and resource banks[15].

Rubrics

Rubrics aimed to capture and systematise ways of thinking and make the core principles of an adopted approach to curriculum development explicit.

For example[16], a 'split-screen' approach to planning and delivering curriculum experiences made sure that staff worked on promoting student wellbeing and developing their independence as learners alongside subject content and skills. A split-screen approach involves consistently using two sides/halves of the computer or interactive white board screen for different types of learning objectives, for example one for subject content and another for cross-curricular skills.

Audits

School leaders in the research reported by the research summary *Learning how to Learn through AfL* strategies used a self-evaluation questionnaire as an audit tool. They asked teachers to complete it before the programme of professional development was fully planned to help INSET leaders identify practices that might need attention or assist their decision about the scale of CPD input that was required.

Planning grids and templates

Using planning grids and frameworks enabled school leaders to monitor change and progress across the curriculum and to embed cross-curricula themes within lessons or subjects.

15 Ibid

16 Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?*, Curee, Coventry

Resource banks
Banks of tools and resources provided staff with practical ways of implementing curriculum development in the classroom and helped them feel confident about doing so, which was particularly important at the initial stages of embedding new approaches to curriculum.

Case study 6 (page 35) shows how the use of tools and resources supported the process of curriculum development in a group of secondary schools.

What tools are linked with positive outcomes for children and young people?

An international review of research[17] exploring links between school leadership and positive pupil outcomes found that selecting, developing and using tools in professional learning was likely to lead to better outcomes for both staff and pupils. The kinds of tools which the researchers found to be most effective included:

- progression frameworks showing learners' developing levels of understanding in a particular subject;
- standards frameworks against which teachers can assess their own and their learners' levels of performance; and
- software which, for example, plots learner progress against time spent in school.

If used in staff professional development and to inform and monitor curriculum development, these tools can help ensure that the new or adapted curriculum is grounded in data about young people's performance and is likely to be effective in achieving better outcomes.

17 Robinson, V., Hohepa, M. and Lloyd, C. (2009) *School leadership and student outcomes: Identifying what works and why: Best Evidence Synthesis Iteration (BES)*, New Zealand Ministry of Education, Wellington, New Zealand. Available at: www.educationcounts.govt.nz/publications/series/2515/60169/60170

Evidence box

The evidence for this section comes from these TLA research summaries.

- Alternative curriculum provision
- Continuing Professional development
- Leading staff development in primary mathematics
- Learning mathematics through collaboration and discussion
- Learning to learn through AfL strategies
- Transforming teaching and learning with ICT

Other evidence is drawn from:

Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?,* Curee, Coventry

Curee and University of Wolverhampton (forthcoming) *Monitoring the curriculum: evidence from research, practice and learners,* Curee, Coventry

Curee and University of Wolverhampton (2008) *Curriculum Evidence: Probe 3 Report - CPD and Curriculum Development,* Curee, Coventry. Available at: **www.curee-paccts.com/our-projects/qcda-building-evidence-base**

Robinson, V., Hohepa, M. and Lloyd, C. (2009) *School leadership and student outcomes: Identifying what works and why: Best Evidence Synthesis Iteration (BES),* New Zealand Ministry of Education, Wellington, New Zealand. Available at: **www.educationcounts.govt.nz/publications/series/2515/60169/60170**

How could you make use of this evidence about whole-school processes that help teachers to develop curriculum experiences effectively?

Suggestions for teachers

- Positive changes to pupil learning and their curriculum experiences are more likely when curriculum development combines the support of peers and specialists. When considering curriculum change, however minor, could you seek opportunities to work with colleagues in, for example, a co-coaching relationship and invite input from specialists (internal and/or external to your school). Who could help you identify the type of specialist knowledge, expertise and evidence you need and help you access it?

- Involving learners in curriculum development can be a good way of promoting engagement as well as creating curriculum that is tailored for their needs, as case study 2 illustrates. Could you work with colleagues from your year group or department to try actively involving young people in curriculum planning? How would you know if your approach had been successful?

Suggestions for school leaders

- Curriculum development is an obvious motor for driving school development priorities. Combining curriculum development and CPD makes for very effective use of resources. Could you encourage your colleagues to consider and discuss which of your school's priorities could be met through curriculum change and/or refinement? At the same time, you may like to support your colleagues' professional development through introducing your colleagues to the evidence in the TLA research summaries.

- Teachers in your school can be involved in curriculum development without realising it. How could you ensure coherence of different approaches adopted across the school? Would a whole staff meeting aimed at assessing current approaches, agreeing whole school principles and

aligning the development work with the school priorities be helpful?

- Tools and frameworks, particularly those that show pupils' progress, are effective for curriculum development and CPD. Could you ask your colleagues to audit the tools they currently use to see how effectively they help colleagues explore impacts on pupils' progress, and whether refinements could be made?

SECTION 3
PLANNING

Teachers need to draw on their subject knowledge and experience, along with knowledge of their own and their learners' learning, to make planning and delivery of the curriculum more effective. Effective curriculum planning involves teachers working collaboratively so that cross-curricular learning can support independent learning (encouraging learners to think and act for themselves). In this section, we focus on curriculum planning in relation to two key elements of curriculum development: planning context-based learning and planning links between home, school and community.

Why is it important to plan for context-based learning?

A review of reviews on curriculum[18] (summarised by the research summary *Curriculum*) highlighted the importance of linking the curriculum with pupils' knowledge and experience of everyday life. The value lies in increasing pupils' engagement with their learning by helping them to see the relevance of the curriculum to their lives beyond school and by adding variety and interest.

There is also evidence that context-based learning can:

- enhance subject knowledge;
- develop a more positive attitude towards subjects;
- improve achievement, increase pupils' ability to engage in productive argument; and
- help widen access to challenging curriculum content.

18 Bell, M., Cordingley, P., Gibbons, S. and Hawkins, M. (2008) *Review of individual studies from systematic research reviews*, Curee, Coventry. Available from: www.curee-paccts.com/our-projects/qcda-building-evidence-base

What approaches can we use?

Key approaches to planning effective, contextualised curriculum experiences highlighted in the research summary *Curriculum* include using simulations, and designing authentic, meaningful tasks.

Using simulations

Many aspects of the curriculum cannot of course be experienced physically within the school environment, but must nonetheless be introduced there, for example via computers or role play.

One example included in the research summary resource involves using video clips of physical events to promote discussion between learners about force and motion. The clips included a tennis ball rolling slowly off a table and an astronaut on the moon releasing a hammer and feather simultaneously. Pairs of learners were asked to predict and discuss what they thought would happen to the flight path of each projectile before watching the end of the video clip.

Case study 7 (page 37) provides a more detailed account of how these video clips were introduced into the lesson and the benefits of specific aspects of the approach.

Designing authentic, meaningful tasks

The research summary of some of Bruner's work *(Jerome Bruner's constructivist model and the spiral curriculum for teaching and learning)* showed how Bruner saw authentic tasks as pupils approaching learning in the same way as adult scholars. The research summary of his work reported how he commented:

> "The schoolboy learning physics is a physicist and it is easier for him to learn physics behaving like a physicist than doing something else."

By 'something else', Bruner meant textbooks that present the conclusions of research rather than centring on enquiry – that is, emphasising the acquisition of factual knowledge rather than solving problems using real life examples. Another way of helping pupils behave as adult scholars is through taking on the role of history detectives – asking questions, hypothesising, discovering clues and following lines of enquiry in order to solve who and what triggered crucial events.

Case study 8 (page 39) shows how a teacher planned a project in which eight- and nine-year old pupils were encouraged to take on the role of history detectives. They took part in a role play in which the objective was to solve the mystery of a suspected murder that took place in 1822.

The research summary Curriculum provided examples of how learning in context and using authentic tasks could be developed across the curriculum by exploring big issues in society.

For example, history, French, mathematics, science and art/music teachers in one school worked together on an interdisciplinary programme involving a study of persecution during World War II. Each department gave the pupils the chance to experience how minorities were treated during World War II through the medium of their particular subjects.

Why is it important to plan for home-school links?

The QCDA curriculum synthesis highlighted the effectiveness of connecting the curriculum to pupils' learning in the home and of involving parents in their children's learning. There are many positive benefits that can result from using links between home and school to enrich the curriculum. Those reported by the research summary *Home-school knowledge exchange* for example, included:

- improvements in pupils' attainment and attitude to learning;
- improvements in parents' knowledge and appreciation of why, what, and how their children are learning in school;
- increased parental support for their children's learning in the home;
- enhanced teacher/parent/pupil relationships, including improved relationships between schools and families from minority ethnic groups; and
- raised status, self-esteem and identity of individual children.

How can teachers develop the curriculum to promote links between school and home?

While schools often set about transferring knowledge from school to home through setting homework for example, transfer of knowledge from home to school is less common. The research reported in the research summary *Home-school knowledge* exchange showed how it was possible to organise curriculum experiences to enable transfer of knowledge in both directions.

Making the school curriculum visible to parents

The *Home-school knowledge* exchange research summary reported how project schools made videos which showed children in their classrooms learning literacy and numeracy. The videos were shown at school and also loaned to parents to view at home to help them understand literacy content and learning materials. They were particularly helpful for showing parents how they could help their children to learn at home. In some schools, parents were invited into school to view what and how children were being taught. This was a particularly powerful form of transfer, as this comment from a parent shows:

> "They had an afternoon where some of the mums went in and they actually taught us for an hour how they teach the children. And it helped so much … it was nice to know how they're being taught, how they break it down … even her teacher said they noticed such a huge difference once I knew what she was doing and was able to give her more help."

Linking home to school through planned curriculum activities

Schools in the home-school knowledge exchange project developed specific activities for transferring knowledge from home to school using photos and artefacts to make connections.

For example, teachers arranged for children to use disposable cameras to take photographs of aspects of their out-of-school lives, such as photographs related to everyday mathematics. The photographs were then turned into displays or books and used to explore learning in different subjects and contexts while also allowing pupils and their families to become better known to the schools. They also helped teachers to understand the different ways some children were being taught out of school. For example, several families of Asian origin used traditional practices of 'strand counting' – counting on fingers and finger joints to represent units.

Case study 9 (page 41) reports how some teachers set about enhancing parents' involvement with their primary and secondary aged children's curriculum at home, and the activities they used as talking points, such as taking photos and collecting artefacts.

How can teachers encourage parental support for children's engagement with the curriculum at home?

Effective ways of organising parental support for children's engagement with their curriculum at home noted by TLA research summaries included curriculum-related pupil-parent joint activity, and designing homework activities to prompt parent-child dialogue about learning and the curriculum.

Curriculum-related pupil-parent joint activity

One example of successfully involving parents (described in the research summary Curriculum) involved parents sharing reading activities with their primary aged children. The research summary Hattie's concept of visible teaching and learning showed that engaging parents actively in their child's learning is key. For example, Hattie found that parents teaching children specific literacy skills was twice as effective as listening to children read.

Using homework to prompt parent-child dialogue about learning

The research summary 'Parental involvement' showed how conversations and discussions parents have with their children at home are essential for enhancing pupil achievement. These conversations can be encouraged by devising interactive homework tasks that extend curriculum experiences, by specifically promoting conversations between parents and their children. Examples of these include activities such as asking pupils to take photos at home and collecting artefacts to take to school and then using these artefacts to contextualise the school curriculum.

Case study 10 (page 43) explores in some detail the benefit of setting homework that has a clear role for parents.

Evidence box
The evidence for this section comes from these TLA research summaries.
Curriculum
Effective provision of pre school education
Hattie's concept of visible teaching and learning
Home-school knowledge exchange
Jerome Bruner's constructivist model and the spiral curriculum for teaching and learning
Parental involvement
Researching effective pedagogy in the early years
Transforming teaching and learning with ICT

Evidence also comes from:
Bell, M., Cordingley, P., Gibbons, S. and Hawkins, M. (2008) *Review of individual studies from systematic research reviews,* Curee, Coventry. Available from: **www.curee-paccts.com/our-projects/qcda-building-evidence-base**

How could you make use of this evidence about planning for curriculum experiences?

Suggestions for teachers

- One way of creating authentic tasks is to plan activities in which pupils take on the roles of adult scholars. Could you work with a colleague to identify curriculum opportunities for pupils to work in occupational roles, such as scientists and historians, to seek answers to questions, collect and analyse data and solve problems? You may like to consider inviting parents to talk about their experiences of solving real-life problems associated with areas of your curriculum.

- The Parental involvement research summary shows that engaging parents in their children's learning is a key factor in pupils' attainment. What counts most is discussion about learning between children and parents in the home to help parents and pupils access the curriculum. Could you plan curriculum experiences that draw more upon conversations between children and their parents and thus provide such conversations? For example, you could set interactive homework activities specifically designed to involve parents, and plan different ways of drawing on such conversations within the curriculum in school.

Suggestions for school leaders

- Using a cross-curricular approach, for example to explore important issues in society, can be a way of planning for context-based learning. Could your staff work collaboratively to identify such opportunities? Your senior leadership team may like to consider the support that staff would need in order to carry out cross-curricular teaching effectively and to use it for extending and deepening learning?

- Effective cross-curricular work will depend on each subject being clear as to what being a 'physicist', 'artist', 'historian' etc involves. Could you ask departments to share and compare core principles and key skills in their subjects so as to encourage meaningful links through better understanding and greater cohesion in the teaching of the skills?

- Parents find it helpful to see teaching and learning in practice, for example through video, observation or direct experience and can learn a great deal about how to discuss learning with their children and then help them make sense of school work in their lives at home. Can you bring together colleagues within a department to consider ways they might bring teaching and learning to life for parents?

SECTION 4
ENACTMENT

Evidence suggests that planning for curriculum content and designing curriculum materials must at the same time involve planning for their enactment in the classroom. Teachers need to plan how the curriculum will be experienced by students or they risk a mismatch between the intent behind the materials and the actual learning processes employed whilst using them. As we said earlier, teachers need deep knowledge both of their subject and of pedagogy to be able to shape the curriculum content and experience in ways that are most beneficial for their pupils. This means that careful planning and design of curriculum content, materials and resources needs also to be accompanied by an appropriate repertoire of pedagogical skills.

The QCDA report[19] around which this anthology is structured found that skills in facilitating group problem-solving and diagnostic skills (identifying pupils' starting points and misconceptions in order to pitch the level of challenge appropriately) are key to successful classroom enactment of the curriculum. A large number of TLA research summaries (see below) provide evidence of why group work, tailoring the curriculum to pupils' starting points, identifying their misconceptions and constructing challenge are important and how teachers can incorporate them effectively into their practice.

How does collaborative group work support the enactment of the curriculum in the classroom?

The research summary about Vygotsky's theories *(Vygotsky's ideas on teaching and learning)* showed the importance to pupils of learning through dialogue, while the research reported in the research summary *Raising achievement through group work* showed the importance of teachers explicitly teaching pupils to engage in exploratory talk (the type of talk that is most effective for thinking and learning). Pupils who engage in exploratory talk, pool ideas, opinions and information; they think aloud together to create shared knowledge and understanding, all important aspects of engaging deeply with curriculum content.

What evidence is there that group work is an effective way of enacting the curriculum?

There is much evidence in the TLA research summaries that delivering the curriculum through structured group work is effective. Besides improving pupils' attainment and achievement it helps:

- pupils to access and engage with the curriculum;
- enhance pupils' reasoning and problem-solving skills across a range of curriculum areas;
- increase pupils' confidence and self-esteem; and
- support increasingly independent learning through good decision making.

19 Curee and University of Wolverhampton (forthcoming) *Monitoring the curriculum: evidence from research, practice and learners*, Curee, Coventry

How can teachers structure group work to enable effective curriculum experiences?

Evidence provided by the research summaries shows that the effectiveness of structured group work depends on teachers providing clear guidance for group working, modelling productive talk, and designing curriculum tasks and activities that help pupils develop the skills they need to work collaboratively in a productive way.

Guidance for group working
The research summary Raising achievement through group work shows the importance of teachers providing pupils with training and support for group discussion. Eliciting ground rules for talk in pupils' own words is one important building block. During a guided discussion, the teacher draws from the class the kind of rules they think should be used in group work (such as asking everyone for their opinion, asking for reasons, and respecting and building on other people's ideas) and displays the resulting list on the classroom wall for pupils to refer to.

Modelling talk
Small group discussion will be important in securing access to many aspects of the curriculum. Teachers can identify when exploration will be most useful and interesting, and then model the kind of talk and the way it contributes to the curriculum.

If teachers introduce new ideas by modelling the types of verbal exchanges that encourage pupils to express ideas, explain reasons and solicit help, pupils have a clear idea of what it might mean to be a historian, scientist, mathematician or engineer. Such modelling starts with using reasoning words ('what', 'how', 'why' and 'because' etc), inviting contributions from several pupils, listening attentively to other pupils, sharing ideas and building on other people's ideas when new content is introduced.

Case study 11 (page 44) shows how a group of primary teachers set about structuring their pupils' talk during group work through establishing ground rules. **Case study 12** (page 46) shows how a group of teachers were trained how to model effective talk and the difference the professional development made to both teachers and pupils.

Designing curriculum activities to ensure group work is productive
The TLA research summaries describe a number of different ways of designing curriculum tasks that will promote collaboration and interaction in group work. They include involving pupils in discussion-rich activities, pupils planning and carrying out learning activities for themselves, and peer assessment activities.

For example:
- the *Collaborative mathematics* research summary describes a number of discussion-rich activities such as asking groups of pupils to make a poster which involved pasting down statements under the headings 'always true', 'sometimes true' or 'never true' and surrounding the statements with justifications and explanations; and
- the *Transforming teaching and learning with ICT* research summary describes how teachers planned learning events for pupils which allowed the pupils to decide on their own learning activities and choose what resources they felt they needed to complete them. They worked together to find out things like the germination and growth of plants and create a PowerPoint presentation or poster to share their learning with the class.

Such activities enabled pupils to learn from each other and shifted ownership of knowledge from the teacher to the pupils.

Why is it important that the curriculum is tailored to pupils' own knowledge, understandings and beliefs?

For pupils to engage successfully with the curriculum, evidence in the TLA research summaries shows the importance of building on and developing their existing understanding in relation to specific curriculum context, and targeting conceptual difficulties.

For example, the research summary *Learning science* describes how a group of science teachers identified conceptual difficulties their pupils had with chemical reactions and equations (such as not understanding that the overall mass does not change during a chemical reaction, or that gases have mass). They then designed lessons to support the pupils in dealing with these difficulties. The lessons involved experimental work and discussion, during which the teacher asked questions directed at the conceptual difficulties the pupils had shown earlier, but did not provide answers. By the end of the study, the learners' test scores were around 20 per cent higher than the scores of a comparison group of pupils who did not participate in the intervention.

How can we find out what pupils already know and can do?

Clearly, before teachers can provide appropriate tasks and resources, they need to find out what individual pupils know and can do already in relation to particular curriculum context. Key approaches to diagnosing pupils' starting points are questioning and asking pupils to explain their reasoning.

Diagnosing pupils' starting points through questioning

The TLA research summaries provide several examples of teachers developing and using banks of questions as diagnostic probes, particularly in science, to enable them to collect data about their pupils' current knowledge and understanding.

For example, the research summary *Learning science* describes how researchers worked with a group of teachers to create two-tier probes that consisted of two questions. The first question asked for a prediction about what the pupil would expect to observe in a given situation; the second then asked for the best explanation for this.

You can find out more about using diagnostic probes by reading **case study 13** (page 48).

Other methods of assessing pupils' prior knowledge

The research summary *Students' views about science theory and practice* describes how a group of teachers devised and developed card activities designed to reveal pupils' current understanding.

For example, the pupils were asked to sort pictures of inherited and acquired characteristics in humans, mammals, invertebrates and flowering plants into those they believed would be inherited and those that would not, in order to reveal the children's beliefs about inheritance.

Another effective way of assessing pupils' prior knowledge and understanding is through writing tasks, such as requiring pupils to produce information booklets designed for younger pupils which require them to explain their ideas on particular topics.

How can we create curriculum experiences that build on and extend pupils' existing knowledge and understandings?

Building on specific existing knowledge

One teacher discovered that her pupils often missed out worded numeracy problems in test situations because they did not know how mathematical words such as 'how many more' and 'what is the difference' related to the symbols for add and subtract etc. She then devised a series of practical activities to bridge the gap. The activities included matching words printed on cards with the appropriate symbols and asking the children to make their own worded problems from two given numbers. After completing the activities, the children's average score on numeracy tests increased from 24 to 83 per cent.

You can find out more about how this teacher diagnosed her pupils' difficulties with worded number problems and how she set about helping them to overcome their difficulties in **case study 14** (page 50).

Challenging pupils' existing understandings

Bruner argued that learning does not have to follow the usual course of cognitive development, but can lead it by providing challenging opportunities which enable the child to forge ahead.

The successful 'connectionist teachers' described by the *Effective teachers of numeracy* research summary held a similar view. One teacher explained how he did not hesitate to provide pupils with challenges they might not succeed at. With one class, he set up a challenge in which the pupils had to compare two pie charts. Both pie charts showed preferences of populations for different pastimes, but one referred to a population of 80 while the other referred to a population of 100. Some pupils did not realise that although 40 people in each sample had stated the same preference (for computers) this did not represent the same proportions of each sample.

Case study 15 (page 52) shows how some geography teachers applied the theory of teaching leading cognitive development. They first observed the way their pupils approached a task, then showed the next step to take their pupils' thinking forwards.

What part do pupils' misconceptions play?

As indicated in the previous section, uncovering pupils' misconceptions or alternative conceptions is an important aspect of finding out what pupils already know. Examples of these given in the TLA research summaries include pupils:

- not appreciating that electric current is the same at all points of a series circuit; and
- thinking $^1/_3$ of a cake is smaller than $^1/_5$ because 3 is less than 5.

How can teachers create curriculum experiences that reveal pupils' misconceptions?

Effective questioning includes asking open and probing questions, prompting pupils to give reasons for their answers, allowing time for pupils to respond, accepting answers without judgement and discussing wrong answers as well as correct ones. It lies at the heart of allowing, and maybe even encouraging, pupils' misconceptions and alternative conceptions to surface. Teachers who create a classroom where all pupils are prepared to give extended answers and reasons for them also create an atmosphere where incorrect responses can be explored and discussed.

How can teachers set about exploring and challenging pupils' misconceptions?

The research summary Collaborative mathematics showed how teachers encouraged the exploration of misconceptions through discussion – not just in whole-class situations, but in small groups too. They used a diagnostic teaching programme designed to expose common learning obstacles which pupils faced in particular aspects of the curriculum and to motivate pupils to reformulate their own understanding of concepts.

There were three phases to the diagnostic teaching lesson:

- exploring pupils' existing understanding and methods – through tests and interviews prior to teaching;
- provoking and sharing 'cognitive conflicts' – by identifying aspects of the curriculum where ideas and phenomena are in tension with each other and/or by getting pupils to compare their responses with those of others, or by asking them to do the same task using a different method; and
- resolving and consolidating conflict – by discussing the new concepts and methods in groups, and then using them on other problems.

For example, groups of pupils were asked to discuss the statement **'In January, train fares went up by 20%. In August they went down by 20%. Fares are now at the same level that they started at'.** The following extract provides a flavour of the ensuing discussion that took place between four pupils.

Andy: That's wrong…because they went up by 20%, say you had £100 that's 5, no 10.
Ant: Yes, £10 so it's 90 quid, no 20% so that's £80. 20% of 100 is 80... no 20.
Dan: Say the fare was 100 and it went up by 20%, that's 120.
Sally: Then it went back down so that's the same.
Andy: No, because 20% of 120 is more than 20% of 100. It will go down by more so it will be less. Are you with me?
Ant: Would it go down by more?
Andy: Yes because 20% of 120 is more than 20% of 100.
Ant: What is 20% of 120?
Dan: 96…
Andy: It will go down more so it will be less than 100.
Dan: It will go to 96.

Another way of addressing misconceptions involves devising specific activities for developing pupils' thinking in the curriculum area where the misconception became apparent. One teacher discovered his pupils used different scientific models for understanding the senses. He felt that his pupils' ideas could be challenged through gathering supporting evidence that would take their existing models into account and enable their models to become more robust. So he devised a series of activities such as using a pipette to place vinegar in a balloon and asking the pupils whether they could smell it, because he thought this might lead them to believe that it is not possible to out-reach to a smell when there is an obstacle in their way.

Find out more about how this teacher established his pupils' existing models of understanding of the senses, and how he used the feedback he gained to inform his teaching, in **case study 16** (page 54).

Why is constructing challenge such as important aspect of the curriculum?

Ensuring pupils are sufficiently and appropriately challenged is important not only for raising attainment and achievement, but also for engaging learners at risk of disengagement.

For example, the Cognitive Acceleration through Science Education (CASE) project described in the research summary *Improving learning through cognitive intervention* showed increases of 10 to 20 per cent in the number of pupils achieving grade C or above in science, mathematics and English GCSEs compared to control groups.

How pupils are challenged is important. A review of challenge in the curriculum[20] reported how gifted pupils were more motivated by the challenge of open-ended investigational tasks in mathematics than exercises selected from text books designed for older pupils. They changed from seeing mathematics as 'boring' to 'very enjoyable but very hard'. There was also evidence of the children extending their thinking through posing their own questions.

20 Curee (2009) *Building the evidence base strand 3, challenge review report*, Curee, Coventry. Available at: www.curee-paccts.com/our-projects/qcda-building-evidence-base

How can teachers construct challenge in the curriculum?

The principles of constructing challenge are similar for all pupils, whatever their achievement levels. They include constructing challenge through differentiated curriculum tasks, materials and resources together with processes such as collaborative enquiry and problem solving. In order to provide appropriately challenging curriculum experiences, it is important to identify and build on pupils' different starting points in terms of existing knowledge and understandings.

Setting differentiated activities

The research summary *Grouping pupils and students* describes how a teacher planned and used differentiated activities and content for Year 7 pupils in a mixed ability English class. The teacher chose different texts based on ballads. The weakest group of pupils worked together on a storyboarding activity based around the American cowboy lament *The Streets of Laredo*, while pupils in the middle groups wrote a ballad about the life cycle of a product based on *John Barleycorn* (the story of making whisky), and the most able group worked together to produce a list of eight questions about the poem, *The Ballad of Reading Gaol*. The teacher worked with each of the groups in turn.

Setting a cognitive challenge

Thinking skills approaches involve setting pupils a 'cognitive challenge' by planning an activity that makes them think. This can be a challenge to someone's usual way of thinking or perceiving the world to bring different subjects to life. It may introduce new information that does not fit with previous experience. The uncertainty arouses curiosity and makes pupils think. The tasks should be interesting and challenging, but achievable with the help of others and so depend on teachers' knowledge of the curriculum content and also of pupils' ideas and conceptions.

In an example described in the research summary *Collaborative mathematics*, pupils studying GCSE mathematics were asked to choose the correct equation from a list of four to express a word problem. The teacher found that each answer

had been chosen by at least one pupil and used the differences between their ideas to engage their interest in the following way:

'Let's be honest. Out of the group here, we have got someone thinking that each of these is correct. They can't all be'.

What issues are involved in constructing challenge and how can teachers overcome them?

Constructing challenge is not without its difficulties – it can be hard to resist helping or challenging pupils who don't want to do things they think they can't do or can't do well. But research shows how learners need to experience periodic challenge and even momentary failure in order to develop higher levels of self-efficacy (belief in their capacity to reach their goals) and task persistence. There are a number of ways of managing challenge, including peer support, scaffolding the learning, giving specific praise, and establishing a 'safe to fail' ethos in which being stuck or initially failing at a task is seen as an important part of the learning process.

Peer support and scaffolding

Once the pupils have been set a challenging task they can work together to solve it, supported by each other and by the teacher. One teacher set up mini challenges such as working in groups to design a selection of party bags of different prices and which contained different gifts. She noticed a big variation in the pupils' ability to plan the challenges, so she provided some scaffolding around the tasks which she slowly removed as the pupils successfully developed their skills and understanding, such as modelling the different group roles.

Case study 17 (page 56) shows how this teacher scaffolded her pupils' learning while engaged in mini challenges in more detail.

Praise

The research summary *Promoting students' persistence in meeting challenges* showed the importance of teachers giving praise that describes precisely the behaviour or aspect of work that was being praised. This involves teachers identifying in concrete ways effective approaches to the curriculum content they plan. For example, understanding strong writing skills and mathematical thinking helped teachers praise a good story by discussing how the pupil made decisions about the plot, and praise the solution to a mathematics problem by asking

what strategies the pupil used. Such specific praise helped pupils to become aware of what made them successful in exploring specific curriculum content, more capable of dealing positively with failure and more open to challenge and attempting difficult aspects of the curriculum.

Establishing a safe to fail ethos

Underpinning many of the TLA research summaries is the belief that learning is about taking risks. Consequently, it is important to help learners see that there is nothing wrong with failing sometimes. Teachers do this by demonstrating that they do not always know the best or 'right' way of doing something and promoting a positive mindset – that if something doesn't work then find another way.

For example, the *Effective teachers of numeracy* research summary showed how one teacher deliberately made mistakes which pupils were expected to identify and correct. This led one pupil to point out, for example, "You multiplied instead of squaring so you put $(-3)^2 = -6$ instead of +9".

Evidence box

The evidence for this section comes from these TLA research summaries.

- Assessment for learning: putting it into practice
- Collaborative mathematics
- Curriculum
- Effective literacy teaching in the first years of school
- Effective talk in the primary classroom
- Effective talk in science classrooms
- Effective teachers of numeracy
- Grouping pupils and students
- Improving learning through cognitive intervention
- Jerome Bruner's constructivist model for teaching and learning and the spiral curriculum
- Learning science
- Promoting students' persistence in meeting challenges
- Raising achievement through group work
- Students' views about science theory and practice
- Strategies for improving pupils' writing skills
- Transforming teaching and learning with ICT
- Vygotsky's ideas on teaching and learning

Other evidence is drawn from:

Curee (2009) *Building the evidence base strand 3, challenge review report,* Curee, Coventry. Available at: **www.curee-paccts.com/our-projects/qcda-building-evidence-base**

How could you make use of this evidence about delivering curriculum experiences?

Suggestions for teachers

- The evidence suggests that successful use of group work to ensure access to the curriculum for all is dependent on pupils being given tasks that promote structured discussion. Could you work with colleagues to pool ideas on discussion-rich activities and aspects of the curriculum that offer the best environment for such talk for subjects you teach?

- Effective planning for the use of questioning is important for diagnosing what pupils already know when planning new topics, subjects or themes. Could you examine your questioning skills (perhaps by videoing or audio recording a whole-class interactive session or by asking a colleague to observe)? Could you identify specific aspects of new curriculum topics (perhaps with the help of a colleague) where you will have an opportunity to build on your current approach by, for example, prompting pupils to give more reasons and accepting all answers without immediate judgement but as a springboard for discussion?

- How comfortable do you feel about planning curriculum tasks that will challenge pupils and allow them to struggle? Would trusting the evidence about how this process can be beneficial to pupils' understanding in the long-term help you to plan for more challenge for groups of students at every level?

Suggestions for school leaders

- This research highlights the importance of knowledge of aspects of the curriculum where there are common misconceptions. Could you invite a group of colleagues to identify typical misconceptions in a particular subject and/or age range to look out for as well as identify possible responses? They could perhaps observe each other as they try them out.

- The principles of constructing challenge include differentiating curriculum tasks, materials and resources in order to provide appropriately differentiated and challenging curriculum experiences at every level. Could you arrange for staff to use INSET and meeting time to share ideas on how to differentiate the curriculum and homework in different subject areas and to gather resources together to help them differentiate the activities they present to pupils?

CASE STUDIES

Case study 1
Improving pupils' achievement in writing through adopting a thematic curriculum

We chose this case study because it shows how one school realised one of its improvement priorities through developing its curriculum.

Why did staff opt for a themed curriculum?

Leaders and staff of a larger than average primary school in the south of England were looking to provide a context for learning that would make it more relevant and would increase the motivation of children to learn. The head was especially interested in how this might help with ongoing work to raise standards in writing at Key Stage 2, which Ofsted had noted could be improved by making it 'more purposeful'. The head teacher believed that a themed approach would enable her to introduce more writing and make it more meaningful and engaging for the children. A themed curriculum was also seen to offer more scope for involving children in choosing and developing curriculum opportunities.

How was the themed curriculum embedded in the school?

Each planning team interpreted the six overarching themes in the curriculum into topics and activities for the children in their year group to undertake. Themes lasted for one term and included foundation subjects and literacy. Mathematics, science, and PE were taught as discrete subjects.

At the end of each term there was a whole class review, which allowed the teacher and the learners to assess learning and evaluate the theme. As part of this process, the next theme was introduced. Children were supported to indicate both their interest and their prior learning through a range of activities, such as brainstorming, mind mapping and whole-class discussion. The planning team refined the range of interests suggested by the children into 'five key questions', which then underpinned planning of the topic for the following term.

Resources to support topic work were developed in school by the planning teams and/or brought in from home. The head teacher noticed a change in the way that teachers and parents communicated after the themed curriculum was introduced. She attributed this to more learning at home through discussion and finding relevant objects to bring into school.

What was the impact?

Standards in writing at Key Stage 2 went up "and it was a good up" (head teacher). Ofsted inspectors considered that:

"The quality of the curriculum is good. It has recently been thoroughly reviewed and carefully planned to ensure that good links are being made across subjects. This is beginning to have a successful impact upon the quality of writing. Writing for a purpose is making the writing process more appealing to boys; for example, older pupils used their note-taking skills well when researching climate and location in a geography lesson. Visits and visitors reinforce specific topics or aspects of pupils' learning and enrich the curriculum by providing a range of stimulating experiences." (Ofsted, November 2007)

Staff attributed such improvement to the freedom they had had to 'move away from the strategies and plan from the [National Curriculum] core objectives'. They considered that this helped 'free up' the curriculum and enabled them to be more 'creative'. But just as valuable to the school was the sense of 'connectedness' and relevance that they felt able to communicate to children and parents:

"It makes it a lot more meaningful for the children. It's not just English and science. Everything in life is connected." (Year 5 teacher)

For the full report see: Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?*, Curee, Coventry

Case study 2
Involving both leaders and learners in curriculum development

We chose this case study because it shows how a school leader's active involvement in curriculum development helped drive and monitor change. At the same time, it also shows how the school (a foundation school for children aged 3-11) supported learners in participating in the ongoing process of curriculum development.

The school used the learning objectives set out in the National Curriculum as the starting point for its curriculum, but thereafter, topics and themes were developed jointly by each year group's learning partnership, which included teachers, support staff and children. This approach enabled the school to make the role of the children in developing their curriculum visible and valued.

What was involved?

At the end of each term a new theme for the next term was chosen by each learning partnership. Tools such as spider diagrams (a form of concept map) and thought showers (resulting in dozens of post-it notes) were used to support each child in exploring their interests and as a way of indicating what they already knew and could do in the context of the theme. Thought showers are a way of encouraging individuals to contribute ideas without comment or evaluation by others.

The children's notes were then used as the basis for producing an outline plan which was reviewed and refined with the children to make sure that everyone found something to interest them. Teachers submitted overview plans to the head teacher to scrutinise each term, then translated them into rough timetables to help them think through the range of approaches they would offer. But these plans were subject to constant revision in the light of new directions taken with and by the children as their learning moved forward.

For the most part, children chose similar foci and the majority of planning was organised around them. However, special interests and choices that did not obviously connect with relevant learning objectives were accommodated too, for example through homework tasks and project work. As a result, many children completed a significant amount of voluntary additional learning, linked to work they were doing in school. All children completed a related project during the long holiday before term started to get them 'warmed up'.

There were no ability groupings in any of the classes and for each curriculum experience, children chose how they wanted to engage from a range of learning opportunities. Groups were fluid, and frequent self and peer-assessment formed the basis for setting the pace of learning. This meant that fixed plans for lessons or sequences of lessons were of little use at the school. The approach also challenged staff to 'keep up' with the imaginations of their children and frequently led them into new territory.

Resources to support learning opportunities grew rapidly and ingeniously to meet the demands of the children and staff. These included a forest school where children regularly explored and learned outdoors, a PA system from which children broadcast to the school, a website full of well-populated and up-to-date blogs and images of the children and their work, and numerous artefacts around the school, including an antique motorcycle. In the playground there was a bus, which was being converted to house the school library so that the space in the school could be turned over to interactive ICT.

How did the school support the change to this curriculum approach?

In the term before the co-designed curriculum was introduced, the head teacher led a series of INSET days, during which staff worked together to 'imagine' a term's worth of work around some themes. Staff also worked in their learning partnerships and received one-to-one coaching from the head teacher.

Staff were encouraged to think about what resources they would need and what approaches might work, and to try out some of their ideas in their current classes. Through this kind of experimentation and review, over the course of the term

staff developed and refined the principles and underpinning practice, and even some approaches and resources that they could actually use.

This approach to implementation had two effects: to raise the level of creativity in the range of approaches; and to build staff confidence that they could let go of the control they held over learning, and so enable the children to take a more active role.

Through one-to-one coaching of individual teachers during the development period and early stages of implementation, the head teacher consistently modelled her high expectations, for example, of the degree of creativity to be demonstrated by staff and children and in particular of the quality of resources she believed would be required to make the approach successful.

Specialist support was made available from both inside and outside the school. The leaders in science, mathematics and ICT are kept especially busy helping colleagues with integrating these subjects into themes. Creative practitioners including singing and drumming teachers have been brought in to complement the skills of school staff.

How was the curriculum approach monitored?

In practical terms, the head teacher reviewed every outline plan and met with learning partnerships and individuals to discuss their rationale and help refine their approach. She frequently and unpredictably dropped in to classes and discussed progress with children and staff both formally and informally, individually and in groups.

The head teacher also completed performance management reviews for all staff, including support staff. No targets were set for individuals relating to pupil performance. Instead the focus was on personal professional development, including mentoring others and taking part in accredited programmes.

Occasionally, the head teacher convened a 'curriculum continuity party'. Staff brought their plans to this so that the overall offer that the school was making became accessible to everyone, and ideas could be swapped and refined. Such occasions also involved staff in reviewing coverage and progression and helped to share the responsibility for securing the quality of curriculum experiences across the school.

Written portfolios were kept for each pupil, and children kept blogs and self-assessment journals that were regularly reviewed by staff and children separately and together.

What was the impact?

The school was recognised twice (2006, 2009) as an outstanding school. Ofsted highlighted the creative curriculum, and in particular the children's role within it, as important contributions to the success of the school:

"Lessons are planned very carefully, often with creative flair and with implicit varying degrees of challenge. Because meaningful links are developed between subjects, there is often planned overlap so that exploration in one subject leads to reinforcement in another. Staff provide the pupils with structured support to ensure that they have the necessary skills to complete the task and tackle the challenges. This is a particularly strong feature of lesson planning." (Ofsted, 2009)

For the full report see: Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?*, Curee, Coventry

Case study 3
Practitioners working with specialists to develop the primary science curriculum

We chose this case study because it shows the value of seeking support from other experts, such as scientists and artists, in curriculum development. The teacher-researcher set out to explore the impact of innovative teaching methods – teaching science through music – on pupil achievement and attitudes in science. The project involved two Year 2 teachers, a musician, a university research scientist, postgraduate students and eighteen pupils.

Staff at the infant school were concerned that science in school was lacking some of the excitement that it once had. They felt that content was being emphasised over investigative skills, and that there was a need for more open-ended, child-initiated learning to stimulate interest and enthusiasm in science.

What support did the external specialists provide?

The teacher-researcher developed ideas she had encountered at a creative science teaching programme in her school by leading in-service training. At the first session, she introduced the teachers to a musician who gave them the opportunity to experience some of the activities that the children and staff would be involved in throughout the week. The musician introduced the staff to the water drum (a drum partly filled with water to modify its pitch and timbre) and other instruments.

Following the meeting, the musician worked with the Year 2 children. The children experimented with the water drum and other instruments, and explored sound and rhythm patterns. The teachers developed the idea of the water drum with the children. They explored whether any of the following made a difference to the sound:

- using different materials for the drums;
- changing the size of the drums; and
- using different beaters.

Working with the university team, the children started to look at changing the pitch and loudness of sounds. The activities included investigating hosepipe trumpets, sound measurement, drain pipes and flip flops, musical boxes and wave patterns using a slinky. The activities enabled the children to explore sound in a variety of meaningful ways.

How did the pupils benefit?

Questionnaires carried out before and after the project showed that by the end of the week, most of the children's attitudes towards science had changed from 'happy', 'OK' or 'confused' to 'excited', with most children indicating that they always or usually liked science. Before the study the children had liked science only some of the time. There was also a shift in the children's perceptions regarding their ability in science.

Following the hands-on activities, the children were able to talk about sound and their learning in some depth, for example:

- 'When the musical box workings were put on the box, the box vibrated. At home when I put my hand on the musical box it vibrates – my hand shivers';
- 'Big bowls made deep sounds, small bowls made high sounds';
- 'The metal tray made a high sound out of the water and a low sound in the water'; and
- 'Hosepipes can make a loud sound. There's not much sound with a long pipe. The air travels so far you have to blow really hard'.

What did the teacher-researcher conclude about her experience of working with specialists?

The teacher-researcher concluded that it was important to:

- be flexible – if an activity does not appear to be working, partners need to adapt activities to the needs/abilities of the children;
- develop an effective working relationship between the teachers and the providers;

- allow time for the relationship to develop, for example, enable staff to meet the specialists before the workshops and experience some of the activities; and
- investigate the impact of the project and share the results with staff.

For the full report see: Chapman, J. (2006) *Creative science,* Summary prepared for the Teacher Research Conference 2006, National Teacher Research Panel. Available at: www.ntrp.org.uk/?q=publications_a-z

Case study 4
Experimentation in developing design and technology curriculum

We chose this case study because it is an example of how a group of teachers in a secondary school experimented with the design and technology curriculum in order to improve the behaviour and effort of boys at Key Stage 3.

Teachers in the department had noticed a decline in the achievement of boys in design and technology. There seemed to be a connection between their attitude to the subject and their level of effort, which was most marked in food and textiles. There was a problem of poor behaviour among boys, for example mistreating equipment and resources and calling out. The teacher-researcher was concerned about stigma and gender stereotypes attached to technology, and was keen to improve attitudes to learning the subject.

What approaches did the teachers experiment with?

Staff in the technology department first considered alternative class arrangements which they felt could have had a positive effect on boys' achievement, for example:
- pupils keeping the same teacher throughout the year and following the teacher to different material areas. But they felt that this would only have been possible with a few groups, because not all staff were able to teach all areas of the curriculum;
- single gender classes; and
- splitting pupils into ability groups to enable lower ability pupils to be put in smaller classes together with support teachers.

The teachers opted for single sex classes because they already had some experience of this at Key Stage 4. GCSE classes were often single gender classes, with girls opting for textiles and boys opting for resistant materials. The teachers also decided to look at different methods of teaching and learning that might help combat the apathy and gender stereotyping within the subject. One of the approaches they tried was lots of short, focused tasks, such as 'SCAMPER'. In this activity pupils looked at how to develop their design ideas quickly by using different prompts

such as combining two aspects of the design, modifying a part of it, or substituting one aspect for another. This was effective as it was short and snappy and kept them focused.

Another approach the teachers tried was 'four by four by four' activities, in which pupils produced a page of different designs in a very short amount of time. The pupils then had to fold the page into four sections vertically and then four sections horizontally. This gave them a page with sixteen squares. They had to write their name on the back and then had four minutes to sketch their first design, for example for a hat. The paper was then passed round the room. The teacher gave out different instructions each time, such as, 'design a hat influenced by the sea or morph two designs into one'.

The teachers also bought new equipment – sharp scissors, colouring pencils and fine liner pens – to improve the quality and presentation of the pupils' work, and a digital camera to take photos of finished work.

What did the pupils think of the new approaches?

A survey of all of the pupils in Year 9 on their views of their experiences within technology lessons over the year showed that:

- 90 per cent of the boys had enjoyed technology;
- 83 per cent of the boys preferred their single gender classes to the mixed classes in the previous year;
- 62 per cent of boys felt that there was an improvement in classroom behaviour; and
- 54 per cent felt that the teacher treated them differently.

Staff too felt better about the classes. As behaviour had improved, staff felt they no longer had to deal with some of the silly issues that occurred previously between boys and girls. In particular, the teacher-researcher felt that her relationship with the boys had improved – she felt much calmer when dealing with a possible explosive situation. The boys were aware of the changes the teachers had made and appreciated them greatly, as this comment showed:

"They make more jokes and Miss is more relaxed and less stressy!"

For the full report see: Postlethwaite, J. (2006) *Boys will be boys? Raising boys' motivation and achievement in Key Stage 3 Design Technology,* Summary prepared for the Teacher Research Conference 2006, National Teacher Research Panel. Available at: **www.ntrp.org.uk/?q=publications_a-z**

Case study 5
Using tools in curriculum development

We chose this case study because it shows how tools supported curriculum change in a secondary school. The study involved a large, inner-city comprehensive school which had decided to introduce the Building the Learning Power (BLP) approach into its curriculum, in response to identifying the need for pupils to take more responsibility for their own learning.

BLP aims to equip learners with the skills and language of learning around four themes: reciprocity, reflectivity, resourcefulness and resilience. This was designed to help them think and talk about the ways in which they learn, and what they can do to improve their learning.

At the same time the school sought to improve pupils' emotional intelligence and general wellbeing through the promotion of social and emotional aspects of learning (SEAL). The school leaders set out to coalesce the BLP and SEAL strands through auditing the two approaches and subsequent aligning of objectives – resilience/emotional and reciprocity/social, as well as through the creation of a fifth R: responsibility.

How did the new approach to curriculum work?

At the senior level, the responsibility for introducing and extending the new approach to curriculum rested with the assistant head, and one of the heads of department who acted as BLP co-ordinator. They arranged for training and ongoing development for members of staff who become BLP teachers, and also oversaw the development of BLP resources. A central mechanism for ensuring BLP was integrated into school life and worked well was a termly BLP review. As a result of these, the BLP co-ordinator made adaptations to the programme, for example changing the language on some of the resources to make it more accessible.

The central BLP team identified and created resources for use across the school, such as posters illustrating the BLP themes, but also encouraged individual departments to develop and adapt their own resources. The technology department, for example, designed resources with the BLP objectives in with its Key Stage3 environment module. Some departments, such as art, English and drama, were particularly proactive in producing visual resources.

In the initial phases of BLP, the school focused on developing a core of staff to teach BLP skills, who then worked with Years 7 and 8. Pupils had one session a week in which they were explicitly introduced to the skills and language of BLP. The mechanism for ensuring that they encountered opportunities to use these language and skills in their learning was the practice of clarifying 'split-screen' objectives at the beginning of each lesson. These consisted of learning content-specific objectives and BLP objectives. Pupils also carried with them a booklet containing the BLP capacities, and presented these to teachers for signing if they felt they had demonstrated a particular skill/behaviour.

In addition, the school created an environment in which pupils could develop BLP and SEAL skills in the form of cross-curricular projects. One scheme the school introduced for Year 7 was 'Dragon's Den' in which pupils worked together to design and market an invention.

What benefits did the curriculum change bring?

From the perspective of the BLP team, the biggest impact BLP had was pupils' increased awareness of how they learn and can improve. This was reflected by a change of pupils' language when talking about school:

"We know that BLP has had an impact because children's language has changed and they are using BLP vocabulary to describe their learning – similarly teachers are writing reports that are much clearer about children's learning and what their next steps should be."

A pupil voice experiment in which a discussion with Year 7 (BLP) pupils about their learning was compared with one carried out with Year 11 pupils (non-BLP) reinforced the perception among staff that BLP developed a sophisticated awareness of learning among pupils:

"We asked them [Year 7 pupils] why they made choices, and they were able to rationalise it. The Year 11s couldn't say why they had done things." (BLP co-ordinator)

For the full report see: Curee and University of Wolverhampton (forthcoming) *In schools that are successfully developing the curriculum, how are the changes required by curriculum innovation being managed by school leaders?*, Curee, Coventry

Case study 6
Collaborative CPD to develop new resources and improve practice

We chose this case study because it shows how CPD, which involved the development over time of new resources, stimulated more interactive teaching, which in turn improved pupil discussion and engagement in mathematics. The project set out to make mathematics more exciting and engaging by encouraging pupils to adopt problem solving strategies, ask questions and explore their understanding by working with others.

What were the key features of the CPD?

Two teachers from each of seven schools and colleges in Cornwall came together in the project. The project leader, the county adviser for mathematics, made a conscious decision to avoid one-off INSET training. Instead the project was based around three half-day input sessions, once per term over an academic year.

The sessions focused on modelling and developing teaching approaches and resources. The teachers were expected to trial, evaluate and develop the methodology collaboratively when they were back at school.

The adviser gave teachers support during school visits, contributing to joint planning and team-teaching. Additional support was available through a private online web portal to enable all the teachers to share their experiences, resources, lesson plans and evaluations. Between them the teachers developed over 50 teaching resources.

What was the impact on classroom practice?

The teachers involved developed a broad range of new resources to support their teaching, such as jigsaws, treasure hunts and card sorts. The aim of the resources was to help pupils understand concepts through collaboration, investigations, questioning and engagement in discussion.

The new approaches moved the teachers away from a traditional teacher-led didactic approach towards one which was pupil-led and emphasised active engagement. Pupils talked about mathematics more, explored ideas together and explained concepts and solutions to each other. Teachers became enablers and supporters of learning in the following ways:

- engaging with pupils in more subtle and unobtrusive ways;
- being more attentive to pupils' conversations and discussions; and
- responding to pupils who were not following productive paths.

What was the impact on pupils?

A number of impacts on pupils were reported by the teachers involved.

Deeper understanding of key concepts
Thinking strategies were improved and discussions led to links being made between topics, leading to greater understanding. One teacher commented:

"You know that feeling you get when you have taught a lesson and you know that the pupils have walked away with a huge understanding of a topic – well that was the feeling I had in spades after the lesson… Not only did they know how to use binomial expansions, they still knew it three months later."

Greater motivation to learn and persistence, especially by weaker pupils
The new strategies engaged pupils who had previously seemed unmotivated by familiar and traditional ways of teaching.

Greater challenge provided for more able pupils
Greater opportunities to think for themselves led to more able pupils stretching themselves more.

Improved uptake of mathematics post-16
Most of the settings reported increased uptake in mathematics courses post-16 and improved retention rates from AS to A2 level.

What effect did this model of CPD have on the teachers?

Generally teachers spoke of the excitement they felt when pupils produced questions or solutions that they themselves had not thought of.

The teachers felt invigorated by their involvement with the project and unanimously expressed renewed enthusiasm for teaching mathematics.

Working with their colleagues gave the teachers the encouragement and confidence to develop and try out their own ideas, but it was important that they were willing to be observed teaching and open to new ideas.

For the full report see: Northern, L. (2008) Enhancing the quality of learning and teaching in post-16 mathematics, Teacher Enquiry Bulletin, National Centre for Excellence in the Teaching of Mathematics. Available at: **www.ncetm.org.uk/enquiry/10296**

Case study 7
Using film clips of real life events to promote peer-learning conversations

We chose this case study because it shows how a piece of computer software that involved clips of real life events was used to prompt collaborative discussion between pupils.

The study involved Year 10 and 11 pupils (18 girls and 26 boys). Working in collaborative pairs, the pupils completed 16 computer-based 'Predict-Observe-Explain' (POE) tasks during two physics lessons at the start of a unit of mechanics. Each class was already familiar with co-operative group work and POE tasks led by their teacher.

The POE tasks prompted pupils to:
- predict the result of a demonstration and discuss the reasons for their predictions;
- observe the demonstration; and
- explain any discrepancies between their predictions and observations.

The computer POE tasks were designed to promote discussion of the pupils' ideas about force and motion. The clips included a child releasing a ball so that it fell to the ground, a tennis ball rolling slowly off a table and an astronaut on the moon releasing a hammer and a feather simultaneously. The pupils were prompted by the computer to predict and discuss what they thought would happen to the flight path of each projectile before watching the video clip. They then compared what actually happened with their predictions, discussing any discrepancies. The researcher created the POE tasks using multimedia authoring software. He filmed some of the video clips used in the tasks himself and used some commercial film.

The researcher argued that the computer could help to support peer learning conversations by giving pupils control over the pacing of the POE tasks and the presentation of the video demonstrations, whilst the real life physical settings depicted in the video clips provided interesting and relevant contexts. The autonomy involved in the computer tasks could give pupils the flexibility and time to discuss their ideas thoroughly, whilst the video clips provided the stimuli for pupils to review their ideas critically, especially if their prediction was incorrect.

The researcher collected a variety of data including observation, audio and video recordings, and interviews with the pupils and teachers to find out the extent to which the computer-based POE tasks promoted meaningful discussion between the pupils. He found evidence that the computer-led POE tasks were as successful as the teacher-led tasks. The pupils:
- articulated and justified their own ideas;
- reflected on and tested out the viability of their own and their partner's ideas; and
- built new ideas and shared meanings together.

How pupils articulated, justified and reflected on their own ideas

The pupils articulated their views of the problems posed by the computer by making drawings of the predicted flight path and discussing the reasons for their prediction. Disagreements between them gave the pupils opportunities to justify and defend their viewpoints. For example, Dave's disagreement with Pat's prediction caused Pat to justify his view in this discussion.

Pat: It's going to go down more than out.
Dave: No. My prediction is it's going to go down heaps faster. It'll go out a little bit and then go down. Not much though. How do you like that? *(Dave made a daft drawing showing the ball moving a considerable distance from the table.)*
Pat: But the thing is it's going slowly – go back a bit – I reckon it's going a lot slower than that Dave.
Dave: Like that? *(Dave edited his drawing, reducing the predicted horizontal range of the projectile.)*
Pat: Yeh – I reckon it's more like that Dave.
Dave: Oh yeh? OK. *(Not quite convinced.)*
Pat: It's going so slow, it'll only get pushed out from the table a little bit before it goes down. *(Defending his view.)*

How the pupils reflected on and tested the viability of their own and their partner's ideas

A feature of the pupils' conversations was the way they frequently performed mini-experiments, particularly during the prediction and reasoning stages of the tasks. The pupils dropped or threw objects such as coins, pencils and pieces of paper into the air, or rolled them off tables. The pupils also frequently made use of hand gestures – they pointed to the video clips on the screen, and traced pathways of objects with their fingers or their pen. These physical actions were often collaborative and provided evidence of pupils reflecting on and testing their own ideas. Sometimes they led to the pupils reconsidering their own views.

There were many incidents where pupils discussed their partner's ideas about the POE tasks. Their conversations were characterised by frequent questioning and silent pauses. For example, Michelle initially disagreed with Cath's drawing. After evaluating each other's ideas, both pupils attempted to provide a detailed description of the ball's pathway. In particular, Michelle tried to justify her own idea that the pathway was steeper than the pathway that Cath had observed.

Cath: OK – play it [the video clip] again.
Michelle: When she throws it, it sort of comes up a bit and then comes down. Do you think or not?
Cath: Um … Well she throws it underarm, she doesn't throw it straight out.
(The pupils watch the video clip again.)
Michelle: See it sort of goes up, then it comes down. *(Drawing picture.)*
Cath: It curls up just a tiny bit, maybe not up like that *[pointing at Michelle's drawing]*. When it starts to drop a bit, it comes down more gradually.
Michelle: Isn't it more than gradually: it's a bit more than gradual!
Cath: Ah … *(pause as both pupils watch the video clip again.)*
Michelle: Don't forget she's a lot higher.
Cath: That's all right, we'll change it.

How pupils built new ideas and negotiated shared meanings with their partner

Whilst there were many examples of pupils' reflecting on their own and their partner's ideas, few groups showed evidence of genuine building and negotiation of new ideas. One pair of pupils that did, bounced ideas off each other in the process of formulating a reason for their predicted pathway of the slow ball rolling off the table.

Anne: Wouldn't it [the ball's trajectory] arch more half way down? I guess it would arch more … it leaves the table. Roly, poly … *(Anne continues to draw the pathway.)*
Jane: Or would it dip or would it just go straight down? I don't know what do you think?
Anne: Yeh.
Jane: It'll just like roll a bit. *(Jane performs a mini-experiment by rolling a pencil slowly off the table.)*
Anne: Sort of like out a bit.
Jane: OK not as much as that but – OK well um – so the ball initially arches slightly away from the table then just drops? *(Looking for support.)*
Anne: Yeh, the ball's motion is still going this way, but due to gravity it's dropping. It doesn't land straight down because it's got [forward] motion.

Although the researcher found many examples of peer learning with computers, generally the pupils did not conduct rich conversations during the (final) explanation stage of the POE tasks. He suggested two possible reasons for this:

- There were some instances where pupils would not admit to incorrect predictions. Pupils from both classes were more familiar with teacher-led POE tasks where the teacher provoked quality comments during the difficult explanation stage.

- Consequently, he suggested that whilst the computer can usefully facilitate collaborative discussion, it may be more appropriate for teachers to facilitate the final explanation stage during a whole class plenary to give groups the opportunity to share their beliefs.

For the full report see: Kearney, M. (2004) *'Classroom use of multimedia-supported Predict-Observe-Explain tasks in a social constructivist learning environment',* Research in Science Education, 34, pp. 427-453

Case study 8
Pupils seeking answers to real questions in history

We chose this case study because it shows how a teacher introduced her class to the approach to investigation used by academic historians – an approach that involves evaluating and interpreting fragmentary and sometimes contradictory evidence from a variety of primary sources.

The teacher developed a week-long local history project for her class of eight- and nine-year olds in which the objective was to solve the mystery of the suspected murder of Samuel Whitehouse, who died in April 1822 in Warley Woods. The project emphasized whole-class enquiry: the children were encouraged to take on the role of history detectives – to think of questions, follow a line of enquiry and make hypotheses. At the end of the project, the children wrote an account of the event and completed questionnaires about their experiences.

As history detectives, the pupils were involved in a number of activities:
- asking questions and hypothesizing;
- discovering clues;
- presenting arguments and developing reasoning skills; and
- writing an account.

The 'history mystery' grew from:
- the discovery of a newspaper report of a trial referring to a possible murder in April 1822;
- a legend surrounding a ghost; and
- architect's drawings of a gothic abbey.

Asking questions and hypothesising

The teacher began the project by giving her pupils the following task:

"Murder most foul! On Wednesday April 3rd 1822 the body of Samuel Whitehouse was found here, with severe head injuries. Your task is to find out if he was murdered. Who or what could have startled his horse?"

The children were shown a horseshoe that had been found at the site. In their role as history detectives, the children were asked to formulate questions that would help them work out what had happened to Samuel Whitehouse. The task was displayed and the children were given worksheets to record their questions on.

To begin with, the children discussed their questions with a partner, then shared their ideas with the rest of the class. All the questions were written up and discussed by the class. Altogether, the children raised 44 different questions, for example:

- Who found him?
- Other than the horseshoe, were there any more things found lying about where the body was found?
- Why was he on a horse?
- What was he doing there?
- Which part of the wood was he found in?

Discovering clues

All the children took part in a treasure hunt on the computer in pairs or independently. The game comprised hyperlinks in MS Word to pages containing information about people, places, maps, facts and interviews related to the trial. The history mysteries game enabled the children to revisit lines of enquiry to help them to remember relevant evidence they could later include in their written accounts.

Presenting arguments and developing reasoning skills

For this activity, the classroom was rearranged to form a court of law. The children decided who could be asked to stand as witnesses (for example, the local blacksmith and publican) and chose children from the class to take on the roles. They also chose a child to be the judge. The other children were expected to take turns in cross questioning and interviewing the key witnesses to try to establish the truth of what happened to Sam Whitehouse. The judge's role was to maintain 'order in court' when the questions came too quickly, and the jurors or the public became too excited. All the children were expected to ask questions and make notes. At the end of the session, the class discussed which questions caused the witnesses to reveal more evidence or detail.

Writing an account

The main writing task was an extended piece of writing in the genre of J. K. Rowling. The teacher began the session by introducing the Gothic building of the Abbey as Hogwarts' Field Centre for Magic Education, and the Grey Lady as Warley Abbey's ghost. The children were shown a picture of Warley Abbey and asked to think of words they could use to describe it. They were given time to reflect on their ideas in their heads, write down notes and then share their ideas with the whole class. The vocabulary they produced ranged from words to describe characters, sounds, smells, magic and mystery.

What did the children learn from the project?

At the end of the project the children were able to put forward a variety of plausible reasons for the cause of Samuel Whitehouse's death and their written accounts reflected the questioning approach they had experienced, for example:

> "Grey Lady," said Harry "Is it true about the murder of Samuel Whitehouse?"
> "Yes, it is true. I saw Sam's horse riding off. And that is all I saw."
> "Thank you. I must go and see where he was found. Tomorrow we are going to find out some clues about when he died. I wonder if he was murdered. Who found him?"
> "I didn't see that."
> "Was the body dead?"
> "I'm not sure about that."
> "Was it the blacksmith who killed him?"
> "I don't think he would do anything like that."

The children's answers to the questionnaire revealed how their ideas about history had changed and how they were more aware of bias and different interpretations of events:

"It made me think that history is a mystery, that no-one knows what happened."

"They [the questions] changed my ideas about history because now I know that people from the past can lie and be truthful."

"They [the questions] changed my ideas about history because I didn't think a murder back then would still be this serious today."

For the full report see: McIlroy, C. (2004) *History Mysteries: History, Literacy and ICT at Key Stages 1 and 2 Harry Potter, the Warley Woods Mystery and Literacy across the Curriculum,* Summary prepared for the Teacher Research Conference 2004, National Teacher Research Panel. Available at: **www.ntrp.org.uk/?q=publications_a-z**

Case study 9
Enhancing parents' involvement in their children's learning at home

We chose this case study because it shows the ways some teachers set about enhancing parents' involvement in their children's learning at home.

The research project took place in 16 schools (primary and secondary) located in inner city and suburban settings in Bristol and Cardiff. The teacher researchers investigated the views of parents, teachers and head teachers about existing home-school practices through parent questionnaires, parent focus groups, and interviews with head teachers, senior staff and class teachers. They used the evidence they collected to inform subsequent intervention strategies.

What did the questionnaires reveal?

Schools

- Whilst teachers believed home-school partnerships were important, they appeared less clear of the role home played in the partnership. Most communication went only in the direction of from school to home and tended to be in the form of written communication.

- The kind of information primary teachers asked for from parents was narrow and focused on the school curriculum, for example, how much reading/writing pupils did at home.

- Secondary schools tended to ask parents to ensure homework was completed and uniform rules were adhered to.

- Many schools sent out a written newsletter in only one language even though their school catered for pupils from different community backgrounds.

Parents

Although welcoming this kind of general information about school, parents suggested they would find it helpful to be given more specific and focused information on their individual child or child's class etc and wanted communication to be

more frequent and informal. They felt that more regular contact than the traditional open evenings would stop issues building up and allow information of a different kind to be exchanged.

As children grew older, communication between home and school appeared to diminish and parents became less sure of their role. Generally, parents regretted that the close links they had enjoyed with the primary school no longer seemed possible with the secondary school.

Reflecting on this evidence led the research teams to consider strategies that might address these concerns. They devised a variety of interventions that both fostered discussion at home and enhanced parents' knowledge about ways they could help their children with their learning.

What interventions were introduced?

Photographs
A Year 1 teacher in Bristol gave her class disposable cameras to take photographs at home that linked to a science topic on plants and growth. The photographs also showed aspects of family life, for example, pets and visits etc. The photographs were used as a basis for a writing workshop, to which parents and siblings were invited to participate. In another school, Year 4 children were asked to bring photographs to school that recorded mathematical activities they had taken part in during the holidays.

Artefacts
One teacher asked every child to fill a shoebox with items they thought would motivate their writing. Parents were asked to discuss the children's choices at home. The contents of the boxes were used in a variety of ways, including oral presentations to the class and story writing.

Video
Videos were used to give parents a view of life in some schools. For example, pupils produced videos for parents, which illustrated methods they had been taught in school to aid mental calculations. In another school, a video of 'A Day in the life of a Year 7' was made and shown to year 6 children and their parents. The video acted as a springboard for discussion about their imminent move from primary to secondary school.

What did the teachers conclude?
The teachers valued taking part in the project and some indicated that the interventions had changed their view about the importance of parental involvement at home and how they could encourage it.

One teacher comment:

"I'm more aware now of what I should be doing, what I could do to help them [parents]."

For the full report see: Salway, L., Scanlan, M. and Stinchcombe, V. (2004) *Exchanging knowledge between home and school to raise attainment,* Summary prepared for the Teacher Research Conference 2004, National Teacher Research Panel. Available at: **www.ntrp.org.uk/?q=publications_a-z**

Case study 10
Involving parents through interactive homework

We chose this case study because it shows the benefit of setting homework that has a clear role for parents.

The researchers of this study set out to investigate whether reading homework designed to be interactive between children and parents would increase parental involvement and also improve pupil achievement. They followed the progress of 84 children aged seven and eight in three schools over four weeks.

In the first school, children were given 20 interactive homework activities and the children's parents were trained in how to help their children with the activities. In the second school, the children were only given the interactive homework activities, whilst the children in the third school were given their usual homework.

The interactive homework activities were designed to help parents ask their children appropriate questions about the texts they read. Following their discussions with their parents, the pupils were expected to write about their inferences in a journal.

The parents' training focused on six key areas.

- Parent-child vocabulary study.
- How to act as tutors whilst their child read.
- Focal points for discussions after the child had read.
- Key points to look for in analysing pupil inference-making.
- How to complete the parent checklist of behaviours.
- Key points to note about their child's reading.

All parents of the pupils in the experimental groups completed diaries, recording how long they assisted their child with each homework task. All the pupils were assessed to determine their ability to draw inferences from a reading selection before the study started and again at the end of the study.

The researchers found that the children who were given interactive homework and whose parents were trained in how to support their children with their homework performed the best in a test of reading inference. The children who were given interactive homework, but whose parents were not trained in how to support their children, performed better than the control group.

The parents of the children who were given interactive homework assignments doubled the amount of time they spent on helping their children with their homework. Before the study, parents reported spending an average of 21 minutes per night helping their children with homework, whilst during the study, parents reported spending an average of 44 minutes per night. No significant difference was found between the parents who had either attended or not attended the training session, in terms of the length of time they spent on helping their children with their homework.

For the full report, see: Battle-Bailey, L., Silvern, S.B., Brabham, E. and Ross, M. (2004) 'The effects of interactive reading homework and parent involvement on children's inference responses', *Early Childhood Education Journal*, 32 (2), pp. 173-178

Case study 11
Structuring pupils' talk during group work

We chose this case study because it shows how a group of teachers set about improving their pupils' speaking and listening skills during group work. The study took place in a primary school in an area of high social deprivation and involved Year 1, 2 and 4 teachers and their classes. The school had an above average percentage of pupils receiving free school meals and pupils registered with special educational needs.

Why did the teachers select speaking and listening as an area for improvement?

Staff at the school recognised there was a lack of social interaction among pupils, which they felt was hindering pupils' ability to develop their speaking and listening skills and affecting pupils' ability to progress in other areas of learning. The staff felt that for sustained improvement they would need specifically to teach the skills needed for effective group work to take place.

What did the teachers do to improve speaking and listening in group work?

The teachers developed a series of 'I can' statements which they shared with their classes. These demonstrated what good speaking and listening might look like and encouraged children to try them out. The 'I can …' statements included:

- I can take a turn
- I can answer a question that's been asked
- I can explain my answer
- I can ask a question about what we are talking about
- I can listen to others
- I can look at the person who is talking to me in a friendly way
- We can make a decision!

Posters containing the statements were displayed in the classrooms for all the children to see and take note of. Using the 'I can' statements as a starting point, teachers observed pupils during an initial group work activity to identify areas that needed developing. The teachers then created ground rules for group work based on these observations and pupils were reminded of them whenever they worked in groups.

Each class worked through a series of four tasks specifically designed by teachers to develop their speaking and listening skills during group work. The tasks for the Years 1 and 2 children included:

- generating ideas for what to do 'if we get stuck on our work?'; and
- planning a party for which the group were given choices they had to agree on.

The Year 4 tasks included:

- working in groups to consider 'what makes a good friend?'; and
- creating a poster on how to stay calm and what is best to do when tempers flare.

The teachers observed the children during each task to identify their areas of strength and weakness. They then used their observations to structure the next group work activity. This ensured children worked on the areas that needed improvement, while at the same time enhancing those areas already strengthened through previous group work activity.

What did the teachers find?

The teachers' observations showed how the pupils' speaking and listening skills improved over the course of the four group work tasks as they grew in confidence and came to understand what was expected. Using the 'I can' statements reminded pupils throughout their group work activity of what was expected of them during group work. Some children began to use the 'I can' statements to regulate others in their groups, for example reminding others that they needed to wait their turn.

The improvement in pupils' ability to listen (rather than talk over each other) also led to an improvement in their ability to answer questions effectively and appropriately. At the beginning of the project, teachers had noted how the pupils made a large number of inappropriate comments during

group work, but such incidences were reduced by the end. But although the children considered their answers a lot more, many of their responses were short – the children found it difficult to elaborate on their ideas. The teachers noted this as an area of further development.

What did the teachers conclude from their project?

The teachers concluded that:

- groups need to be small to give children a greater opportunity to talk and be heard;
- groups need to have a mix of personalities for successful learning – the children need to be in a group where they feel confident to talk;
- speaking and listening needs to be embedded in all subjects; and
- pupils need the opportunity to work collaboratively on a regular basis.

For the full report, see: Bilborough, K., Hawes, L. and Dixon, L. (2008) *Can we improve the standard of speaking and listening during group work?,* Summary prepared for the Teacher Research Conference 2008, National Teacher Research Panel. Available at: **www.ntrp.org.uk/?q=publications_a-z**

Case study 12
Training teachers to model effective group work talk

We chose this case study because it provides details of a professional development programme designed to enhance teachers' skills at promoting effective group work discussion and the impact the teachers' CPD had on collaborative pupil learning.

Teachers were invited to participate in a two-day workshop run by the researchers (academics from a university education department) designed to introduce them to the basic principles of co-operative learning. The workshops included information on how to establish problem-solving tasks that were open and discovery-based so the children would be required to interact about the task, and share information and ideas as a group.

One group of teachers was also trained in how to challenge children's thinking and promote meaningful engagement with the task. These included the skills of:

- reflecting meaning (for example, commenting 'It sounds as though …');
- tentatively offering suggestions (for example, commenting 'Have you thought about …?');
- reframing statements to enable children to consider an alternative perspective (for example, commenting 'On the one hand, I hear you saying that you're stuck, but on the other, you seem to be indicating that you've found the solution. I wonder what it is?'); and
- validating efforts and focusing on key issues and solutions (for example, commenting 'You've worked that part out after a lot of hard work. I wonder what you may need to know now if you want to find the solution?').

These interactions were non-directive, yet designed to challenge the children's understandings and perspectives with the intention of helping them to focus more clearly on the problem to be solved. The teachers took part in role-plays with other teachers to practise the skills. In their groups, they were asked to:

- think and talk about their reactions to the role-play situations;
- assess the quality of the skills they were practising; and
- hypothesise about how the children would react to the specific communication skills.

The researchers moved between the groups, encouraging them to think and talk about their reactions to the use of communication skills, and how they might be used in classroom settings to promote discussion and thinking among group members.

The teachers who were not given the communication skills training spent an equal amount of time with the researchers, and each other, to embed co-operative learning activities into specific classroom lessons. This included discussing curriculum issues, resources needed for planning these lessons and ways of evaluating the effects of co-operative learning. What difference did the professional development make?

All the teachers were audio-taped during lessons in which they used co-operative learning activities. Their interactions were coded into categories such as instructing, prompting, questioning, disciplining, and praising pupils. The study found that the teachers who had received additional training in the specific communication skills designed to challenge children's thinking prompted the children and asked questions nearly twice as frequently as the teachers who had only been trained to embed the co-operative learning activities into their lessons. The teachers who had received the communication skills training were also four times less likely to have to discipline their groups than their peers.

The teachers who had practised and reflected on the specific communication skills extended their pupils' understanding and thinking in a variety of ways, including:

- probing and challenging the children to identify issues;
- tentatively offering suggestions;
- acknowledging, clarifying and validating children's ideas and understandings;
- confronting discrepancies in the children's thinking; and
- focusing on key issues.

Examples of teachers' use of communication skills

"What makes you think [having a long breeding season] might be adapting?" (*challenging the pupils to extend their thinking and see if there are other issues they might consider)*

"Because you think that's how they cope with the environment." *(clarifying the children's ideas)*

"Did the information you read give you any information why?" *(probing and suggesting the further information they might need)*

"So you think it gives them longer to look after their young so they can adapt." *(acknowledging and validating the pupils' understanding)*

"Right, well done!" *(acknowledging effort)*

"Excepting, Georgia just read this bit of information here." *(confronting discrepancies)*

"Now what you as a group have to decide is whether you want to put it under adaptation or under another feature." *(helping the group to focus on the key issue)*

The study also found that the children used the verbal behaviours modelled by their teachers in their discussions with each other. They encouraged each other, challenged each other's thinking and sought each other's opinion. This is an example of one such discussion that took place when a group of children worked together to write a report about penguins:

"What do you think about this? I wrote down" *(gives information about penguins)*

"That's pretty good." (encouragement of another pupil's efforts)

"What are you going to write down?" *(challenge to group member)*

"Enemies would be … ? What do you reckon enemies would be?" *(challenge to group's thinking)*

"Any other features? What do you reckon?" *(seeks group's opinion on other information to be included)*

For the full report, see: Gillies, R.M. and Boyle, M (2005) 'Teachers' scaffolding behaviours during co-operative learning', *Asia-Pacific Journal of Teacher Education*, 33 (3), pp.243-259

Case study 13
The use of diagnostic probes

We chose this case study because it shows how secondary school teachers designed and used diagnostic probes to explore their pupils' existing thinking about a number of scientific phenomena. The study involved 200 pupils in 10 classes at a school in West Yorkshire. The pupils were mainly from Years 7, 8 and 9.

The aim of the study was to uncover pupils' existing ideas about natural phenomena which they will study. Specifically, the teacher-researchers planned to:

- investigate how diagnostic probes might be used to uncover these existing ideas;
- identify the role which diagnostic probes could have in the teaching and learning of science; and
- find out if they were effective in identifying pupils' alternative conceptions.

How did the teachers devise and develop the diagnostic probes?

The teachers acknowledged that they could identify pupils' understanding of scientific concepts through a range of existing methods such as interviews, concept maps, pupils' writing, games, conflict situations and pencil and paper tests. However, they believed these approaches were time-consuming; they wanted an approach which would identify pupils' levels of understanding within an area of science, yet remain an unobtrusive part of teaching.

The teachers reviewed research on children's understanding in science, particularly the categories of ideas which pupils have, and used it as the basis for developing the probes.

In each of the areas chosen, the teachers devised probes and trialled them with a small group of pupils. The results of these tests were then analysed and compared to the findings of previous research. The categories uncovered by the probes enabled the teachers to further refine the probes prior to use with the main test groups of pupils. This case study focuses on the topic of inheritance.

What did research say about children's conceptions of inheritance?

The review of research revealed that the following ideas were held by pupils.

- Some features are inherited from parents.
- Humans are more unique than similar, that is we are all different from our parents and each other.
- Boys inherit more things from their fathers than girls and vice versa.
- Different organisms inherit features to different degrees. Humans inherit many of their features, then mammals, then other animals, but plants inherit only to a small extent.
- Acquired characteristics are inherited particularly if the feature has been present for a long time in the parent or if it has been present over several generations.

Note for non-scientist readers

There are several misconceptions here. All living organisms inherit features from the parents to similar degrees. Whilst each individual member of a species is unique, there are many more similarities than differences between members of the same species, but it is not surprising children focus on the differences.

There are a small number of inherited characteristics that are linked to the gender of the adult, for example, the tortoise-shell coats of some cats are almost entirely found in females, and haemophilia in humans is much more common in males than females. Common characteristics present in humans, such as eye colour, hair colour, tongue rolling, etc. can come from either parent.

Acquired characteristics can appear to be inherited if they occur in the same family over many generations, perhaps an occupation that seems to be 'passed down', or an interest in

something, but acquired characteristics are perpetuated through a constant similar environmental pressure or condition rather than through a genetic inheritance mechanism.

Overall, the research suggests that children have poorly formed ideas about the purpose of sexual reproduction.

How did the teachers explore pupils' views about inheritance and what did they find out?

The teachers created three probes to explore this area of science.

- **Features.** In this probe the pupils were asked to sort pictures of inherited and acquired characteristics in humans, mammals, invertebrates and flowering plants, into those they believed would be inherited and those that would not. This showed the extent to which the nature of the organism influences children's beliefs about inheritance.

- **People.** Pupils predicted the likely appearance of the son and daughter of a couple whose features differed in three ways. This explored whether pupils thought inheritance was gender-linked in humans.

- **Puppies.** Pupils were given a picture of a dog and were asked to predict which three features could be passed onto its puppies. Two of its features were labelled as having been acquired since birth. This showed the sorts of features pupils thought could be passed from parents to offspring.

Teachers found that their pupils' beliefs and ideas were consistent with previous research reported in the literature. Pupils largely agreed about which features would or would not be inherited by humans. There was less agreement about inheritance in plants and invertebrates. Most pupils believed that features such as height and hair colour are sex-linked, that is parents pass features onto a child of the same sex. Pupils tended to believe that features influence genes as well as vice versa. The earlier a feature was acquired in the life of an animal, the greater its chance of being passed on to the next generation.

What did the teachers suggest probes can be used for?

The teachers initially regarded diagnostic probes as a means of providing teachers with the ideas that pupils have as a starting point for teaching and learning. But as the study progressed, they realised that the probes could be used for a number of purposes including:

- measuring pupils' existing understanding prior to teaching a topic;
- as a learning activity to challenge and stimulate pupils' thinking;
- to assist teachers in reviewing and developing schemes of work; and
- enabling teachers to set targets for individuals and groups of pupils.

For the full report, see: Nixon, D., Kirk, H. and Needham, R. (1998) *The use of 'diagnostic probes' to aid teaching and learning in science*, TDA, London. Available at: **http://www.ntrp.org.uk/?q=publications_a-z**

Case study 14
Making meaning clear in mathematics

We chose this case study because it shows how teaching staff at one school set about increasing their pupils' familiarity with mathematics vocabulary to enable them to complete worded problems more successfully. The study involved 18 Year 3 pupils with a range of mathematical ability, at a small rural primary school with 99 pupils on roll.

Starting point

The Year 3 staff (one teacher and two teaching assistants) had noticed that often pupils would not attempt to complete worded numeracy problems in test situations; they would usually miss them out in favour of numeric sentences including a mathematical function symbol. Similarly, in lessons that focused on using and applying mathematical knowledge, children would be very de-motivated and some would be quite distressed. Many required a lot of input before they would attempt the questions. Worded problems led to low scores in numeracy tests.

Before introducing any teaching interventions, the staff set out to obtain accurate baseline scores for these types of questions, and then interviewed the children to find out exactly what they thought about worded problems, and why this was the case. When the teacher announced to the children that they were going to have a test with worded problems, there were immediately cries of, 'Oh, no!' from many of the children, and several children became visibly upset. When the papers were handed out, 10 children raised their hands within the first 30 seconds to say they were stuck, and asked for assistance. The staff explained that it wasn't a test for them to worry about; it was just so that they could see what they needed help with and asked all the children to try their best independently.

The average score for the test was just 24.4 per cent. Several of the answer sheets had comments on such as 'I hate maths' written on them, and one child had drawn a cartoon of a sad face, with tears running down its cheeks. When the staff interviewed a sample of the children to identify their feelings and concerns about these types of questions, they found:

- many children felt quite nervous or scared by worded problems because they perceived them as being very difficult. ("I can read it and read it again, but I just can't figure it out");
- the children preferred mathematical calculation questions because "it is more obvious what you have to do"; and
- questions frequently contained mathematical words that the children did not understand. ("Why can't they just write it in a number sentence, then I'd know what to do?")

Improving the pupils' understanding of mathematics vocabulary

Identifying words meaning a mathematical function

As the children clearly did not understand many of the words that could mean each mathematical function, the staff felt it important to focus on familiarising them with a wide range of vocabulary. They devised a game whereby groups of children had to make flowers by putting the petals (containing words) onto the correct central flower part by matching the words to the symbol on the centre. They used this game to facilitate discussion about the vocabulary.

The results backed up the interview findings that children did not understand the required range of mathematical vocabulary. During the beginning of the session, without teacher input, the following comments were overheard:

- Is minus add? I don't know!
- What is difference? Is it add?
- Is repeated addition times? No, it's add!
- 'How many more' must be add, because 'more' means add!

After the children had all had a go, the staff took each term in turn and decided the correct place for it with the children. This activity highlighted the fact that there was enormous confusion around the range of mathematical vocabulary, much more than the staff had anticipated. They therefore decided to focus initially only on vocabulary meaning add or take away.

As a next step, the staff gave out more worded problems and asked the children to highlight the words in the question that

told them what to do. They specifically told the children not to answer the questions, just to decide what type of question it was: add, take away, divide or times. Reassuring the children that they did not have to 'do' the question just yet took away their fear of failing a test, and allowed the staff to continue focusing only on vocabulary. They ended up with questions looking as follows.

- Gita has 54 Christmas cards to write. She has written 33. **How many more** need to be written?

- Selo had 45p, but lost 20p. **How much has he got left?**

The staff discussed these questions with the children to help them see the different ways the vocabulary could be used.

Making number sentences out of worded problems
To take the children to the next step of decoding worded problems, the staff continued with the previous activity, but this time they asked the children to underline the numbers they needed to use, as well as highlighting the words that told them what to do with those numbers. They also asked the children to take this information and write it as a number sentence, but not to actually answer the question yet. They ended up with, for example, the following number sentences:

The bus is taking **48** children home. At the first stop, **13** children **get off**. How many are **left?** (48-13=?)

This activity proved to the children that worded problems contain a lot of unnecessary information, and showed them that all they have to do is identify the important information so that they can make a number sentence, with which they feel more comfortable. Once the children had worked out all the number sentences, they were asked to go back and try to answer all the questions, pointing out that they could now 'ignore' all the words, as they had simple number sentences to do instead.

Getting the children to write their own worded problems
The staff asked the children to make a worded problem from two numbers that they provided. The staff provided the numbers for the children to emphasise the quantity of 'irrelevant' information within worded problems. By using the same numbers, they hoped the children would provide a lot of very different-sounding questions that would actually translate to the same number sentence as in these examples.

- Mrs Hedges has 84 sweets and she eats 53. How many sweets has she got left? (84-53)
- The aquarium has 84 fish in a tank and they sell 53. How many are in the tank now? (84-53)

What was the effect of improving the pupils' understanding of mathematical vocabulary?

At the end of the intervention period, the staff asked the children to complete another word problem test. This time the children did not complain at all, they took it in their stride. All of the children attempted all of the questions indicating a vast impact on their confidence to have a go. The average score dramatically increased from an average of 24.4 to 83.0 per cent (the lowest score was 62.5 per cent and the highest was 100 per cent).

It was also apparent that in the majority of cases where the answer given was wrong, all the correct information had been identified; a correct number sentence had been given, but a mathematical error meant that the mark was missed. Although on these occasions a mark could not be given, it was apparent that the children had gained the necessary skills and confidence to decode worded problems.

For the full report, see: Mattley, C., Hedges. R. and Hession, H. (2009) *How can we improve the confidence of pupils so that they will have a logical attempt to complete a worded numeracy problem?* Full case study available on request from: **info@curee.co.uk**

Case study 15
Using geography mysteries to scaffold pupil learning

We chose this case study because it shows how teachers set about diagnosing their pupils' thinking and how this enabled them to provide a next step that would move their thinking forward.

The geography teachers made use of 'mysteries' in this study. Mysteries offer the possibility of observing pupils working in ways that reveal their thinking processes.

The first aim of the study was to identify differences in the ways that high- and low-achieving groups tackled the mysteries. It found that groups progressed through a series of observable stages of thinking. The second aim of the study was to see how teachers used their knowledge of these stages of thinking to scaffold pupil learning.

The metaphorical term 'scaffolding' is used for the instructional support, often in the form of adult-child dialogue that is structured by the adult to maximise the child's development or growth. As the child develops increasing mastery of a given task, the adult gradually withdraws the support, until eventually, the initial scaffolding is removed altogether.

To scaffold a pupil effectively, the teacher needs to stay one step ahead of the pupil, always challenging them to reach beyond their current ability level. The first application of the word 'scaffolding' to an educational context is attributed to Bruner (1978, see Further Reading) who observed the way parents interact with their children to help them learn.

What are mysteries?

Groups of two to four pupils are presented with 15 to 30 pieces of information on a topic (for example, hurricanes or earthquakes) with each piece of information provided on a separate slip of paper (the data items). The information includes trigger and background factors. The group is also given a question to answer. For example:

'There was an elderly couple living in Kobe, Mr and Mrs Endo. One of them died in the earthquake disaster – which one and why?'

The group is encouraged to use as much of the information they have been given as possible when formulating their answer. Not all of the information given is necessarily relevant to the question.

What stages were involved in tackling mysteries?

Five progressive stages of thinking were identified by the study.

- **The display stage.** Simply spreading out the data items on the table so that they could all be seen and read easily.
- **The setting stage.** Organising the data items into sets with common characteristics, usually arranged as columns or blocks.
- **The sequencing and webbing stage.** Identifying relationships between the sets or between single items.
- **The reworking stage.** The establishment of new sets of relationships between the sets or between single items.
- **The abstract stage.** The physical manipulation of the data items ceased, but the discussion continued.

How were the stages of thinking identified?

A range of data was collected during the study.

Photographs of all the groups as they worked on a mystery on a set time interval, to provide a simple time lapse of how the pupils physically arranged the slips of paper.

Videos of high- and low-achieving groups doing mysteries.

Interviews with groups of pupils using a technique called stimulated recall, which involved showing pupils a video of their group doing a mystery and asking them to comment on what they were doing and thinking as they worked.

Observation notes of the pupils that were photographed and videoed.

The data were then analysed on two fronts.

- The photographs were compared with the observation notes to define phases that pupils generally went through when physically arranging the data.

- The notes and transcripts from the pupil interviews were compared with the phases in data manipulation to calibrate these stages with pupils' descriptions of their thinking.

How did the teachers use mysteries to scaffold learning?

Through the mysteries, the teachers were able to observe their pupils' thinking skills, or lack of them, whilst they tackled the mysteries. Because a teacher could see which thinking strategies a pupil was using, and could place it within the progressive stages, they could suggest a next step that would edge the pupil onto the next stage in their ability to reason and process data.

Example 1
A low-achieving group of four 12-year old boys were doing a mystery which concerned the disappearance of a tribe of Amazonian Indians. The slips of paper included information about, for example:
- gold prospectors;
- water pollution;
- infectious diseases;
- hunting practices; and
- poverty among the non-Indian population.

The group was having great difficulty with the mystery. The teacher pulled out a data item about the tribe's water supply. She then asked them to find any other data items about water and left them to work alone. With this action, the teacher had diagnosed a weakness shared by the whole group in classifying and grouping data, and demonstrated how they could undertake the next stage in working towards a solution.

When the pupils had grouped several data items about water, the teacher returned to suggest that they might form a group about diseases and health. This enabled her on a third visit to start asking them about the possible connections both within and between the two groups of data items. The pupils thus took their first steps on formulating an explanation.

Example 2
A group of 14- and 15-year olds of higher ability were doing a mystery that focused on who was to blame for the need to demolish a block of public housing flats in a British city. The data items included reference to:
- the faulty materials and technology used in the building;
- the anti-social behaviour of some of the residents;
- the destruction of the community which lived in the terraced houses that were cleared to build the high-rise blocks;
- the physical deterioration of the building; and
- the fears of residents in the flats with young children.

A group of girls had initially sorted their data into two groups: one representing reasons for the demolition and the other against. But in fact, they were not addressing the task and were classifying in an unproductive way. When their teacher pointed this out to them, they began to re-sort the data bearing in mind the need to attribute blame or reasons. This time they formed groups related to the local council, the builders, the anti-social residents and the government.

Example 3
Another group of higher ability 14- and 15-year olds were about to do a mystery on hurricanes. The teacher asked the pupils how they could go about tackling the task. They volunteered six strategies, including sorting more and less important reasons, making it into a story, working out a time sequence and sorting relevant from irrelevant information. By doing this, they revealed that not only did they have a range of strategies, they had the beginnings of a language to talk about cognitive processes.

For the full report, see: Leat, D. and Nichols, A. (2000) 'Observing pupils' mental strategies: signposts for scaffolding', *International Research in Geographical and Environmental Education*, 9 (1), pp.19-35

Case study 16
Finding out about pupil learning and using the feedback gained to inform teaching

We chose this case study because it shows how a teacher at one school found out about pupil learning in order to plan future practice.

The school involved was a primary school located in a fairly prosperous and culturally diverse residential area. The teacher set out to find out about Key Stage 2 pupils' prior learning in an aspect of science before carrying out teaching. In this way it was possible to develop activities that challenged and built upon the pupils' ideas. The teacher concluded that previous teaching had not taken into account the pupils' prior learning and therefore had been ineffective in addressing misconceptions.

How the teacher gained feedback

The teacher was particularly interested in pupils' models of understanding of the senses. Each pupil in Years 3 to 6 (335 in total) was given sheets depicting a seeing, hearing and smelling clip-art scenario. They were asked to 'use lines, arrows and words to show how you see, hear and smell'. Using lines and arrows in this way was a common feature of national testing at the time. The pupils worked on their own to complete the task, after which a sample of 30 were interviewed.

What the feedback showed

The drawings and annotations suggested that pupils had five models for understanding hearing, seeing and smelling. These were:

- the receptor – nose, eyes and mouth;
- outreaching – an active seeking-out of stimuli;
- sensing-as-instant – a belief that stimuli and events interact simultaneously;
- clashing-arrows – a meeting of outreaching and stimuli somewhere outside the body; and
- arrows-both-ways – a dynamic interaction between stimuli and receptor.

Examples of responses from the pupils which illustrate these five models were:

- the light bounces off objects into your eye;
- the nose smells the vinegar and the smell goes to our mouth;
- the sun shines on the flowers and that way our eyes can see the flowers;
- sound will come out of the whistle and that way you can listen to the sound; and
- our nose smells the vinegar and tells us.

The teacher found that the pupils' models were totally different for each of the senses; they were driven by the context. Very few pupils who used the receptor model for one sense used it for all three. Additionally the outreaching and sensing-as-instant models were particularly prevalent.

Next steps

The teacher suggested that the pupils' ideas needed to be challenged and that gathering supporting evidence was a good way of doing this. This would enable their scientific models to become more robust. In order to do this it was important to take their existing models (such as out-reach) into account.

The teacher felt that a possible activity for developing the pupils' thinking about the sense of smell would be to use a pipette to place vinegar in a balloon and ask them to consider whether they could smell it. He thought this might lead them to believe that is not possible to out-reach to a smell when there is an obstacle in their way. After this, balloons could be filled with vinegar and inflated. The teacher thought the pupils might be surprised to find that they could now smell the vinegar. With further thought and scaffolding, the teacher thought they might suggest that gas particles escape through holes in the balloons' walls and move towards an understanding of the nose as a receptor.

In order to develop their understanding of hearing, the teacher thought pupils could observe a slinky. He felt that once they had been told that sound waves travel through the air in a similar way to the way the coils move in a slinky they will begin to realise that they do not need to outreach with their ears.

As seeing seemed to be the most problematic sense, the teacher thought it may be best for pupils to first develop their understanding of smell and sound. Once they had done this, he suggested getting the pupils to wear blindfolds in a darkened room and switching on the lights and asking the pupils whether they can see anything. If they say that they can't because the blindfold is acting as a barrier, then the teacher could ask them whether they can see anything through the sides of the blindfold and challenge them to explain how this can be possible if the blindfold acts as a barrier. With their blindfolds off and their eyes closed again, the teacher could ask them why they can tell whether the light is on. The teacher felt that taking part in these activities could lead pupils to realise the limitations of the outreach model and move to a receptor model.

The teacher's conclusion

The teacher concluded that it was important to find out about pupils' ideas and use this feedback to construct meaningful learning experiences.

For the full report, see: Cuthbert. A. (2006) *Do children have similar models of understanding for seeing, hearing and smelling?*, Summary prepared for the Teacher Research Conference 2006, National Teacher Research Panel. Available at: **www.ntrp.org.uk/?q=publications_a-z**

Case study 17
Managing challenge through scaffolding

We chose this case study because it is an example of how one teacher supported her Years 3 and 4 pupils when engaged in critical skills challenges. The challenges involved pupils working collaboratively in groups to complete a specific task.

Starting point

After having observed the children carry out a number of challenges, the teacher felt she needed to break the whole process down into smaller, more manageable tasks. The main issue was that the end product was more important to the pupils than the process.

For example, the children were given a mathematics challenge in which they were asked to design a set of party bags containing a selection of gifts. The task involved:

- ensuring each bag was different;
- costing individual bags; and
- finding the total cost.

The children were so caught up in designing a bag that the contents were very much an afterthought! The teacher therefore wanted to improve her organisation and delivery of the challenges.

Scaffolding the challenges

The challenges were very open tasks and for many children they needed a great deal of scaffolding to become meaningful learning experiences. In order to effectively scaffold them, the teacher used a combination of tools, such as a timeline with questions which focused on how they would achieve their outcomes, and the use of rubrics (evaluation frameworks) at different stages of the process. With the rubrics, the teacher found it important to make a distinction between criteria that focused on the product and those that focused on the learning.

Example rubric for making a poster: A consumer report about the best cloth

Category	Gold star +	Gold	Silver	Bronze
Required elements	The poster includes all the required elements as well as additional information	All required elements are included in the poster	Most required elements are there	Several required elements are missing
Use of class time	Excellent use of time. Project completed well within time scale. All on task.	Used time well during each class period. Usually focused on getting project completed and little distraction to others.	Used some of the time well during each period. Usually focused on the project but occasionally distracted others.	Poor use of time. Easily distracted. Distracted others. Project unfinished.
Attractiveness	The poster is exceptionally attractive in terms of design, layout and neatness	The poster is neat and well laid out but may need more thought put into the design	The poster is acceptably attractive although it may be a bit messy and have a poor layout	The poster is distractingly messy or very poorly designed. It is not attractive.

Structuring the groups

The teacher found that not only did the task need to be scaffolded, but the groups needed to be appropriately structured too. Non-participation by some pupils was a problem, but improved for most when they were given an immediate role, such as being given the responsibility of ensuring everyone contributed an opinion. The factor that seemed to determine the success of this approach was the group dynamic rather than the individual pupil's ability to take on the role.

Encouraging pupils to use tools designed to help them make progress with their learning

Assessing and evaluating learning was one of the most difficult parts of the challenges. Giving pupils who took on the role of group facilitator a rubric which indicated their learning helped ensure the group focused on their learning during the challenges. The rubrics supported them by setting out the kinds of learning behaviours they should be looking out for and encouraging in others.

For the full report, see: Fleming, G. (2008) *Rubrics: a self-evaluation tool that supports children's learning*, Summary prepared for the Teacher Research Conference 2008, National Teacher Research Panel. Available at: **www.ntrp.org.uk/?q=publications_a-z**

SELECTED FURTHER READING

Related research

Building the Evidence Base Strand 3 Review of individual studies from systematic research reviews. Qualifications and Curriculum Authority and Centre for the Use of Research and Evidence in Education. Available at: **www.curee-paccts.com/our-projects/qcda-building-evidence-base**

Building the Evidence Base Strand 3 Challenge Review. Qualifications and Curriculum Authority and Centre for the Use of Research and Evidence in Education. Available at: **www.curee-paccts.com/our-projects/qcda-building-evidence-base**

Pedagogy and professionalism: A commentary by the Teaching and Learning Research Programme and the General Teaching Council for England. Available at: **www.gtce.org.uk/documents/publicationpdfs/gtc_tlrp_prof_ped0610.pdf**

Summaries of research

Short digests of research on themes related to this anthology are available on the Department for Education's website: **www.education.gov.uk/schools/toolsandinitiatives/tripsresearchdigests**

Teacher Learning Academy (TLA) research summaries

There are more than 50 TLA research summaries, each appraised, selected and produced for the GTC's Research for Teachers series by the Centre for the Use of Research and Evidence in Education (Curee).

Whether you want to find out more about something of interest or you are planning your own research or enquiry, the summaries provide reliable evidence on a wide variety of topics.

Each study helps to:

- illuminate the complex tasks involved in teaching;
- enable teachers to identify clear links with their own pupils and practice; and
- provide detailed information about particular teaching and learning approaches in classrooms.

All summaries are available at **www.gtce.org.uk/teachers/rft**. It is envisaged that the site will remain open for some time following the expected closure of the GTC on 31 March 2012.

Parents

Getting engaged: possibilities and problems for home-school knowledge exchange

High school outreach and family involvement

Parental involvement in raising the achievement of primary school pupils: why bother?

The effects of interactive reading homework and parental involvement on children's inference responses

Pupil grouping

Reasoning as a scientist: ways of helping children to use language to learn science

The effects of cooperative learning on junior high school students during small group learning

Speaking and listening

Talk, talk, talk: Teaching and learning in whole class discourse

The impact of collaborative group work on pupils' science learning

Improving the quality of pupils' talk and thinking during group work

Widening access to educational opportunities through teaching children how to reason together

Online resources

Challenge – thinking skills

CPD – investigating thinking skills:
www.teachers.org.uk/node/10475

Cognitive conflict in mathematics:
www.ncetm.org.uk/mathemapedia/Cognitive+Conflict

History detective kids website:
http://pbskids.org/historydetectives/parentsteachers/parents.html

Mysteries for kids:
www.suite101.com/article.cfm/poetry_stories_kids/22834

Primary science teaching ideas:
www.teachingideas.co.uk/science/contents.htm

Thinking through geography:
www.geoworld.co.uk

Thinking through geography:
www.sln.org.uk/geography/thinking_through_geography.htm

Context-based learning

Concept cartoons:
www.conceptcartoons.com/science/news.htm

Everybody writes:
www.everybodywrites.org.uk

Films for learning:
www.filmsforlearning.org

Maths at work:
www.ncetm.org.uk/resources/5705

Group work

Concept cartoon:
www.conceptcartoons.com/science/news.htm

Talking for success:
http://talking-for-success.open.ac.uk/

Thinking together:
www.thinking-together.org.uk/

Misconceptions

Addressing science misconceptions:
http://newyorkscienceteacher.com/sci/pages/miscon/index.php

Common misconceptions in science:
http://homepage.mac.com/vtalsma/misconcept.html

National Centre for Excellence in the Teaching of Mathematics (NCETM) – Learning from misconceptions in mathematics:
www.ncetm.org.uk/resources/21276

National Strategies – Learning from misconceptions in mathematics:
http://nationalstrategies.standards.dcsf.gov.uk/node/86792

Home-school links

Engaging with parents:
www.ltscotland.org.uk/learningteachingandassessment/partnerships/engagingparents

Helping your students with homework:
www2.ed.gov/pubs/HelpingStudents/index.html

Teachers TV videos

The DfE no longer supports Teachers TV which has therefore now closed. However in spring 2011 the DfE stated that Teachers TV videos will be made available on line in due course: see their announcement at **www.education.gov.uk/schools/toolsandinitiatives/teacherstv**

We recommend that you follow this link for developments.

The following Teachers TV videos are of particular value in creating a curriculum for learning.

Proven to work – detective work in history

KS2 group work collaborative activities

Proven to work – collaborative enquiry

Proven to work – structured groups

Proven to work – structured groups creating a marketing campaign

Proven to work – structured groups creating posters

Involving parents

Hot research – parental involvement

Working with parents – getting parents into schools

General Teaching Council for England

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